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**ENCYCLOPÆDIA MEDICA**





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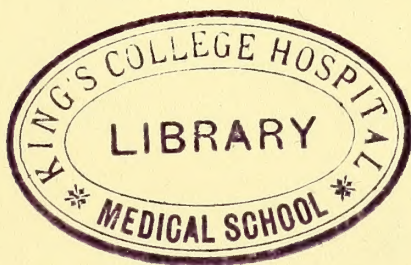


# ENCYCLOPÆDIA MEDICA

VOLUME XV

BEING

*FIRST SUPPLEMENTARY VOLUME*



EDINBURGH AND LONDON  
WILLIAM GREEN & SONS

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## PREFATORY NOTE

THIS, the first supplementary volume of the *Encyclopædia Medica*, deals chiefly with Medicine, Midwifery, Gynecology, Diseases of Children, Dermatology, Materia Medica, and some allied subjects. It supplies an estimate of the progress which has been achieved in these departments of medicine during the past five years (the fourteenth volume of the *Encyclopædia Medica* having appeared in 1904); and the attempt has been made to deal more particularly with real advances in knowledge than to enumerate every passing phase of medical theory and practice.

The articles (135 in number) have been written by experts in the subjects with which they deal, and all of them, with the exception of some five or six, have been specially prepared for this volume. Dr. J. Stewart Fowler and Mr. Henry Wade have acted as sub-editors in the departments of Medicine and Surgery respectively, and Dr. Cranston Low has been in charge of the section on Dermatology. Just as in this volume the majority of the articles have been concerned with Medicine, so in the next supplement it is intended that Surgery shall have the leading place.

J. W. BALLANTYNE,  
*Editor.*

*December 1909.*





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## Abortion.

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FREQUENCY.—Since the beginning of the twentieth century there have been indications that abortions were occurring with greater frequency, at any rate among the civilised nations of the West. Indeed, this rise in the abortion-rate has formed one of the most disquieting features in the alarming phenomenon of race-suicide; and, taken in association with the falling birth-rate, threatens the supremacy of the present world-powers in the near future. The fact that it is impossible to get exact statistics of abortions (for there is no system of registration of miscarriages, and it is difficult to see how any such system could be devised and applied) hardly lessens the dismay with which one must regard the wastage of antenatal life which is taking place; the unknown is terrible to us. But, while there are no statistics *en masse* upon this subject, there have been indications which must be regarded as significant.

J. M. Doléris (*Ann. de gynéc. et d'obstet.*, Paris, 1905, 2 s. ii. pp. 206-224), for instance, has shown that in his own hospital (Maternité de l'hôpital Boucicaut) there was a marked increase in the number of abortions; in 1898 there were 43 abortions and 457 full-time labours, while in 1904 the number of abortions had increased to 130 and the full-time labours were only 497. Further, in 1898 there were 45 premature labours, and in 1904, 102. The abortions had trebled, the premature labours had more than doubled, and the full-time labours had shown only a slight increase. But Doléris discovered other facts still more disquieting. There was evidence obtained from more than 50 per cent. of the patients that the abortion had been artificially provoked, and in some cases a catheter, by means of which fluid could be injected into the uterus to induce the miscarriage, was got. These instruments, it may be remarked parenthetically, were known and asked for as "canules anglaises;" and the herbalist who sold them stated to Doléris's agent that her fee for instruction in the mode of using them was 25 francs. Whilst none of the facts elicited by Doléris were new—for such methods of inducing abortion have long been known and practised—the novelty consisted in the freedom and openness with which their employment was carried out. The physician of the hôpital Boucicaut carried his research still further, and obtained statistics of abortions from ten other institutions (Port-Royal, Baudelocque, Tarnier, Hôtel-Dieu, Pitié, Charité, Lariboisière, etc.) for the same term of years

(1898-1904) as in his own Maternity. The figures for some years and in some cases were incomplete; but even if this incompleteness be admitted, they nevertheless showed an alarming percentage increase in the number of miscarriages in most of the hospitals named. The increase was least marked in the hospitals which did not, on account of rules, small number of beds, etc., admit miscarriages freely, while in five hospitals (Tenon, Beaujon, Lariboisière, Saint-Antoine, and Boucicaut) it was most pronounced. The percentage in the Tenon and Saint-Antoine had trebled in the seven years (from 5 per cent. to 15 per cent., and from 6 per cent. to 18 per cent.), it had more than doubled in the Maternité de Boucicaut (from 7·8 per cent. to 17·7 per cent.), and it had nearly doubled for the Lariboisière and the Beaujon. Adding to these hospitals the Charité, Doléris obtained the following figures:—in 1898 there were 376 abortions (5·6 per cent.), and in 1904, 1341 abortions (16 per cent.). Another disquieting fact was the increase in premature labours during the same period of seven years. To put the matter very plainly, the abortions and premature labours had steadily and largely increased, whilst the full-time labours had remained stationary, had increased only slightly, or had actually decreased.

Doléris is inclined to give to Neo-Malthusianism a large place in the etiology of these cases of abortion. In the public mind the difference between using means to prevent the occurrence of pregnancy and to bring about the early termination of an existing gestation has been obscured, while the desire to limit families to two children or to have none at all has been inflamed by the teaching and advice given in certain books and pamphlets and at certain public conferences. A slide shown on the lantern screen to an audience of five or six hundred people not far from the Boucicaut Hospital is reproduced; it gave in tabular form the means of preventing conception, and named them *physiological* (removal of ovaries, modification of uterine endometrium, extra-genital emission of semen); *mechanical* (use of condoms, sponges de Chypre, absorbent wool, pessaries); and *chemical* (douches, etc.). On this and on similar public lectures and conferences, Doléris makes this scathing reflection, “La science, et quelle science! a-t-elle jamais été mise au service de pires idées?” The prevailing gloom of Doléris’s article is lightened only in one direction, and that is found in the suggestion that a knowledge of the risks of induced abortion has sent more patients into hospital to receive the antiseptic treatment there obtainable, and so to get a maximum degree of security. It is cold comfort surely.

It is not from France alone that evidence is forthcoming of the increasing frequency of abortion. In 1904 L. Lewin (Berlin) published a work of 383 pages, entitled *Die Fruchtabtreibung durch Gifte und andere Mittel*, and in it he expressed his conviction that there was going on a rapid increase in the criminal production of abortion in all countries. He pointed out that the prevention of conception was an act which carried with it no legal punishment, and that the means of securing such immunity from pregnancy were openly written about and described in the public prints; and he emphasised the fact that when prevention failed and conception occurred, recourse was very often had to the criminal procedure of inducing abortion. Prüssmann (*Zeitsch. f. Geburtsh. u. Gynäk.*, 1905, liv. pp. 372-377) has drawn the veil aside, and has shown to the world an instrument which a woman could herself employ to get rid of her pregnancy: he has told how women



learned to feel the os with the finger of one hand, and with the other hand to introduce the nozzle of the instrument into the cervical canal, and so to inject a solution of lysol into the cavity of the pregnant uterus. Prüssmann was led to show this instrument, which was openly sold "for the treatment of discharges," because of the marked increase of cases of abortion in the Gynecological and Obstetrical Clinics; thus in the latter there were, in the two years previous to the reading of his paper, respectively out of 3283 cases, 808 abortions, and out of 3188 patients, 951 abortions.

In England and Scotland, also, abortions would seem to be increasing. Sir A. R. Simpson (*Scott. Med. and Surg. Journ.*, 1905, xvii. pp. 481-496), in an address on "Criminal Abortion," said: "Our Transatlantic colleagues deplore the extent which the evil practice has attained in America, where the number of men and women who are known to make a business of abortifacient seems to be greater than in Europe. Great Britain is in no position to cry shame on any of its neighbours." That there was some foundation for Sir A. R. Simpson's foreboding has been demonstrated by a remarkable series of articles and letters in the *British Medical Journal* during the past three years on the subject of the increasing use of lead as an abortifacient (*Brit. Med. Journ.*, i. for 1905, p. 584; ii. for 1905, p. 130; i. for 1906, pp. 257, 259, 428, 456, 499, 556, 620; ii. for 1907, p. 1672, etc.). The lead was taken apparently in the form of diachylon pills (it will be remembered that diachylon contains *emplastrum plumbi*); and, although it was present only in small amount in each pill, the effect when sixty-one pills were taken in a week (as in one of Hall's cases, *Brit. Med. Journ.*, i. for 1905, p. 587) could scarcely fail to be serious. The practice was specially prevalent in the Midland Counties of England, but was evidently spreading rapidly (Hall and Ransom, *Brit. Med. Journ.*, i. for 1906, pp. 428-430). The diachylon was bought in the form of penny lumps and made up into pellets. In a fatal case, reported by J. G. Priestley (*Brit. Med. Journ.*, ii. for 1906, p. 778), the pills were found to contain from 50 to 70 per cent. of diachylon, with aloes to prevent constipation, and boric acid; but the more common practice appears to be the use of diachylon itself in irregular lumps.

CLASSIFICATION.—For a good many years obstetricians have been satisfied with the arrangement of the causes of abortion into the three groups of *paternal*, *maternal*, and *ovular*; but, obviously, this is far from being a perfect classification, for *paternal* causes are dubious, and *ovular* ones can only be recognised after the miscarriage has taken place, and after the contents of the uterus have been submitted to examination. F. J. Taussig (*Amer. Journ. Obstet.*, lviii. pp. 654-662, 1908) has tried to make a more scientific etiological arrangement of miscarriages, although he admits that "what we do not know concerning the causes of abortion is far greater than what we do know." There are two subdivisions, the *predisposing* and the *exciting*. The former he divides into three groups: (1) *increased sensitiveness to nerve irritation*, arising from (a) temperament; (b) frequent abortions in quick succession; (c) or the incidence of a menstrual date: (2) *greater tendency to placental thrombosis*, due to (a) endometritis; (b) uterine congestion from constipation or sexual connection: and (3) *lessened resistance to expulsion of the uterine contents* from (a) the presence of cervical lacerations; or (b) the antecedent amputation of the cervix. The latter (the exciting) causes are placed in five groups. There is (1) *mechanical irritation*, which may be



either (a) *transmitted*, as in the occurrence of a blow or fall, or of prolonged jarring (as in railway travelling, dancing, etc.), or of straining (as in constipation); or (b) *direct*, when the irritation may be applied to the outside of the uterus, as in the case of adhesions dragging or pushing the organ out of place, or from its manipulation during the bimanual examination or in a laparotomy, or to the inside of the uterus, as in the introduction of foreign bodies (sound, bougie, etc.), or in the presence of an excessive quantity of liquor amnii, or of intra-uterine tumours, or of exudates or clots. There is (2) *thermic irritation*, which may affect the whole body as in cold sea-bathing, or only the pelvic region as in the use of hot vaginal douching or the hot sitz-bath. There is (3) the important group of cases produced by *toxic irritation*, due to chemical, bacterial, or placental toxins: among the chemical agents may be named all emmenagogues (*e.g.* ergot), lead-poisoning, and carbon dioxide; among the bacterial, the various infectious diseases of the mother; and among the placental, the poisons arising in the course of eclampsia, hyperemesis, chorea, and acute yellow atrophy of the liver. There is (4) *nerve irritation*, which may be psychic (including emotion, fright, severe pain) or reflex (operations on external genitals, irritation of the breasts, etc.). Then the last group (5) is that in which the exciting cause is *death of the fœtus*, and this may be due to congenital inanition (alcoholism or illness of parents), congenital deformities, interference with nutrition (maternal anæmia, placental thrombosis, or umbilical torsion or knotting), infectious diseases of the fœtus, or, simply, hyperpyrexia. Taussig's classification is pathogenetic rather than etiological; it has the advantage of leading the obstetrician to form a more scientific conception of the mechanism at work in the production of each case of miscarriage; but it has the disadvantage of overlapping, for it is quite conceivable that one and the same case might require to be placed in two or even three of the subdivisions which are enumerated. Still there can be no doubt that some classification such as this will be required if our knowledge of the intimate causation of abortion is to be advanced.

ETIOLOGY.—Any advance which has taken place in our knowledge of the causation of abortion during the past five or six years has been rather in the direction of a more exact acquaintance with the means which were being illicitly employed to provoke the premature emptying of uterus than in that of the investigation of the pathological causes of abortion or their mode of action. In a word, our increased knowledge refers to criminal rather than to natural or unprovoked abortion. At the same time a few facts regarding ordinary abortions have been noted or emphasised. J. W. Ballantyne (*Internat. Clinics*, 11 s. ii. p. 231, 1901) insists upon the recognition of the clinical fact that there exists a great difference between what he terms the "uterine irritability" of one patient and that of another, the most directly abortifacient measures failing to induce a miscarriage in one woman, the slightest cause (a slip of the foot on a polished floor, etc.) at once sufficing to do so in another woman. Munro Kerr (*Operative Midwifery*, p. 518, 1908) associates this "irritability" with the habit of aborting, admitting, however, that the latter is more usually the result of special diseased conditions, which, if carefully searched for, will be discovered. "Still, in spite of the most careful examination, there are cases where a peculiar irritability of the uterus seems to be the only cause." It may be noted, in passing, that J. W. Taylor (*Brit. Med. Journ.*, i. for 1903, pp. 835-838) prefers the



term "recurrent" to the more commonly used "habitual abortion"; he would limit the use of either term solely to the cases in which from the beginning of married life or from a definite period in it every pregnancy has ended prematurely; and he is of opinion that a "strumous" family history is as important as syphilis in the causation of recurrent miscarriages, the low vitality of one or both parents accounting in both groups of cases for the premature emptying of the uterus. One novel cause of abortion may be referred to—the Röntgen rays. M. Fraenkel (*Zentralb. f. Gynäk.*, xxxi. p. 953, 1907), at any rate, used them to induce therapeutic abortion in the case of a tuberculous woman who was three months pregnant; twenty-five sittings, lasting from five to ten minutes each, were needed before the contents of the uterus were discharged; and, since Fraenkel believes that the abortifacient action of the rays is due to the degenerative changes set up by them in the ovaries and the thyroid gland, he recommends their use (in place of oophorectomy) in cases of osteo-malacia.

But, as has been said, it is along the line of the investigation of the means of provoking abortion among the laity that there has been progress during the past five years. We now are better able to define the measures which abortion-mongers (not always outside the medical profession, it must be reluctantly confessed) employ to bring about the emptying of the gravid uterus. The *British Medical Journal* (ii. for 1907, pp. 1657, 1672) has thrown a sudden light into this dark place in professional and non-professional practice. In a leading article on "Emmenagogues in the Newspapers" the following passage occurs:—"Complaints peculiar to the female sex furnish a rich hunting-ground for these unscrupulous quacks. It is unnecessary for their purpose to employ the large and detailed newspaper advertisements familiar in other cases; a small paragraph, with some heading that will catch the eye, announcing a remedy for 'all irregularities so prevalent with the sex,' or, in many cases, merely implying the purposes for which it is put forward, appears to suffice. . . . If the bait is taken the game begins in earnest; the sufferer is supplied with printed matter, often with the addition of personal letters, setting forth the virtues of the article in question, but nearly always with the reservation that in certain obstinate cases a more powerful medicine is required, which can be supplied at a much higher price. . . . The most serious consequences, however, are quite apart from the swindling of the purchaser of these nostrums. A considerable number of them are recommended in such a way that the suggestion that they can be used as abortifacients is very thinly veiled. . . . The purpose for which these preparations are expected to be taken is plainly shown by their being accompanied in so many cases with advertisements of quinine pessaries and various appliances for preventing conception." That the language used in this quotation is not exaggerated is fully proved by a perusal of the results of the investigation of "secret remedies" carried out by the *British Medical Journal* (see, for instance, pp. 1657, 1658, *Brit. Med. Journ.*, ii. for 1907).

Of the part that is being played by the medical profession in the production of abortion we would fain hope that estimates are exaggerated; but a few lines may be quoted from Frank H. Jackson's article (*Amer. Journ. Obstet.*, lviii. pp. 662-670, 1908) indicating the opinion formed therein on this matter. "To our disgrace, the men who are performing most of the abortions in this State (Maine) are not outcasts from their



profession; some of them are members of this State society and its county branches . . . they are often pointed out as honest, hard-working physicians, yet some of them will kill a baby in its mother's womb with as much compassion as the butcher in the abattoir performs his daily work. Putting it at a conservative estimate, I believe that there are performed fifty thousand abortions annually in this State." It is to be hoped that Jackson's estimate is excessive; but if it be at all near the mark, then it is high time for the adoption of such a clause in the statutes of the State of Maine as is suggested, viz. "Whosoever shall by any means whatsoever bring about, commit or attempt to commit an unlawful abortion, or whosoever may aid or abet in such abortion or the bringing about of such abortion, shall be guilty of a felony."

Elsewhere (p. 3) we have taken notice of the evidence regarding lead-poisoning in the artificial production of abortion; and it seems to be undeniable that diachylon in the form of pills is being largely used to terminate pregnancies (*Brit. Med. Journ.*, i. for 1906, p. 428; and *Lancet*, ii. for 1907, p. 83). Reference may here be made to the belief that lead-poisoning in the case of the husband may have an abortifacient effect upon the wife. Professor Oui (*Compt. rend. Soc. d'obstet., de gynéc., et de pédiat. de Paris*, ix. pp. 33-36, 1907) relates the case of a woman—the wife of a stereotyper—who gave birth first to three infants who died in early infancy, then after her husband had suffered from lead colic she bore seven dead and macerated foetuses; but, further, the man had been married before, and had had a living child by his first wife, and he had also had a living child by this woman, but these two births were before he became a stereotyper. Professor Oui refers also to Brouardel's statement regarding the wife of a house-painter who had five miscarriages in succession and who then gave birth to a healthy full-time child; when she was questioned, she admitted that she had grown tired of aborting, and had on this occasion chosen a healthy man to be the father of her offspring. It is difficult to explain exactly the manner in which lead-poisoning in the husband causes abortion in the wife, for it is difficult to imagine that a spermatozoon can carry sufficient life to impregnate an ovum, and yet, at the same time, sufficient death (so to speak) to bring to an end the gestation it has thus initiated: one wonders whether the wife has not been poisoned by the lead in some other way than through the ovum. But, of course, the same difficulties arise in connection with paternal syphilis.

There is a question which may be asked here—which is asked sometimes by the patient herself: If the actual abortion be prevented, more especially if it threaten on several occasions and be finally averted, will the infant suffer in any way from the early dangers through which it passed? No answer to this question can as yet be formulated; on *à priori* grounds it is reasonable to fear evil results for the child, but, as a matter of fact, many threatened abortions go on to the full time and end in the birth of perfectly normal and living infants. At the same time, it is interesting to note that lead-poisoning in the parents has been followed by the presence in their offspring of idiocy, imbecility, epilepsy, and of macrocephaly with convulsions (Ballantyne, *Antenatal Pathology*, i. p. 262, 1902); and in a case reported by Heelis, Jacob and Trotman (*Brit. Med. Journ.*, i. for 1906, p. 257), a hydrocephalic foetus was borne by a patient who confessed to taking three or four diachylon pills daily for a week with the hope of producing abortion; the child survived its birth for a few hours, and after the post-mortem examina-



tion the liver was found to show traces of lead. Now, it is well known that lead in the mother's circulation may reach the foetal tissues; it is also a well-known peculiarity of lead to attack the nervous tissues by preference; and it is therefore not improbable that the lead which this mother took to induce abortion while failing as an abortifacient may have succeeded in causing structural defects in the nervous system of the foetus.

DIAGNOSIS.—No great advance in the means of diagnosing abortion falls to be recorded. The first step must always be the diagnosis of pregnancy, for of course there can be no miscarriage from a non-pregnant uterus; and every means of recognising early pregnancy which may be discovered will aid us in the recognition of the interruption of pregnancy. Further, the great advances which have been made in our knowledge of ectopic pregnancy (*vide* ECTOPIC PREGNANCY) must ultimately help us more clearly to differentiate between this morbid state and abortion; in the meantime, it must be confessed that the two are very often confused. Sittner (*Deutsche med. Wochensch.*, xxix. pp. 743, 759, 787, 1903), Rudaux (*Clinique*, i. p. 246, 1906) and many others have pointed out the frequency with which an ectopic gestation has been regarded as a threatened abortion, and, conversely, a miscarriage has sometimes been taken for an extra-uterine pregnancy. In the former case the expulsion of a uterine cast may lead the medical attendant to the conclusion that the threatened has become a complete or an incomplete abortion, while all the time there may be a tubal pregnancy. In such cases reliance must be placed on the bimanual examination carefully carried out, and the detection by this means of a tumour at the side of or behind the uterus when it is an ectopic gestation, and the absence of this swelling when it is an uncomplicated abortion. The difficult cases are the retroversions of the gravid uterus and the interstitial and cornual pregnancies. It has sometimes been maintained that the cervix uteri does not soften in ectopic pregnancy, and that this negative sign may be used in diagnosis; but Pinard (*Compt. rend. Soc. d'obstet., de gynec., et de pediat. de Paris*, v. p. 108, 1903) insists that softening occurs whether the gestation be extra-uterine or intra-uterine, and that the firmness which is sometimes observed is due to the death of the ovum. It is easy to mistake an "angular pregnancy," *i.e.* a case in which the ovum is implanted in the corner of the uterus over the tubal ostium, for an extra-uterine gestation; and it is difficult to imagine a means of differentiating the one from the other, especially if the latter be of the tubo-uterine variety (Munro Kerr, *Trans. Edin. Obstet. Soc.*, xxxiii. p. 185, 1908).

TREATMENT.—In the management of abortion there are several questions which must still be left unsettled; but, on the whole, there is a more marked tendency for operators and teachers to come into line upon all the more important matters. Nothing can be added to the various precautions which have been recommended in cases of *recurrent* abortion; but no obstetrician must omit the searching examination of the local and systemic organs of any woman who has repeatedly aborted, every care must be taken to remove or modify any causal state (uterine displacements, endometritis, syphilitic poisoning of one or other parent, etc.), and no rules can be too rigid for the hygiene, week by week, and even day by day, of any patient who has had several miscarriages.

In the case of a *threatened* or *evitable* abortion there is an increasing tendency to exhaust every means of prevention before labelling the case



(even in one's mind) as unavoidable. With a falling birth-rate it has become of the greatest importance to conserve antenatal life (Ballantyne, *Trans. Edin. Obstet. Soc.*, xxxii. p. 23, 1906-7), and medical men are beginning to find that many threatened miscarriages may be averted if prolonged and rigorous care be taken. There is no noteworthy addition to our means of combating the tendency to abort: most practitioners rely on clearing out the rectum with an enema, on the insertion of a morphia suppository, and on strict maintenance of the horizontal posture, with absence of all mental excitement and emotional disturbance. Medicines other than opium cannot be said to have established themselves as better uterine sedatives than morphia. There has been no increase in the means of preventing the emptying of the uterus; but there has been increased rigour in the use made of the means already known and tested. So long as the uterus continues to grow, even if hæmorrhage also continue to some extent, so long may the hope of the continuance of the pregnancy be retained.

When, however, it has become evident that the abortion is *inevitable*, it is an almost universal practice to endeavour to obtain the complete emptying of the uterus as quickly as possible. While there are still some practitioners who prefer to trust to vaginal douching, followed by vaginal plugging and the administration of an oxytocic drug (*e.g.* ergot or quinine), there is an increasing tendency to evacuate the uterus with greater rapidity and completeness by means of the finger or the ovum forceps. If the os be dilated to the extent of allowing two fingers to pass in, it is difficult to understand why there should be any delay in emptying the uterus digitally, unless indeed it be the fact that by so doing the interference comes to be regarded as an "operation," and is necessarily accompanied by the administration of an anæsthetic. The advantages of this rapid evacuation are the thoroughness with which it can be carried out (the operator's left hand pressing down the uterus so as to bring its whole interior under the influence of the curetting fingers), the diminution of the probability of any fragments of the sac being left behind, and the shorter convalescence which follows. Of course the vulva should be thoroughly cleansed and the vagina douched (before and after the scraping out of the uterus); the cavity of the uterus should also be washed out with a two-way tube, sterilised water at 118° F. being used, and the douche not being held high; and the uterus and vagina should be packed with gauze (iodoform, nosophen, or simple sterilised). Whilst this plan of procedure is being more generally adopted in cases of inevitable abortion, there are still many men (*e.g.* H. J. Boldt, *Journ. Amer. Med. Assoc.*, xlv. p. 791, 1906) who would trust to vaginal packing and the use of an oxytocic if the cervix be not dilated. Undoubtedly the closure of the cervix causes a difficulty which can only be got over by dilatation with metal or rubber cones or with the more slowly acting tents; a risk is thus introduced, but it must be remembered that an inevitable abortion with a closed cervix is always a dangerous case, and it is maintained by some that the dilatation of the cervical canal (with a carefully prepared tent) and the rapid emptying of the uterine cavity do not increase but diminish the consequent risk. Of course the dilatation must be carried out with care, and the aseptic precautions must be complete.

In *incomplete* abortions nothing is to be gained by waiting, for the use of oxytocic drugs (such as ergot) cannot be trusted to cause complete emptying of the uterine cavity. If necessary, the cervix must be



dilated and the interior scraped out with the finger (rubber gloves being worn), or the curette; but if the case is already septic, it will be safer to trust to the finger than to the curette (Lepage, *Ann. de gynéc. et d'obstet.*, 2 s. iii. p. 321, 1906), for pelvic cellulitis is apt to follow the use of the latter under such circumstances (Munro Kerr, *Operative Midwifery*, p. 530, 1908).

No great change has been made in the treatment usually given to a *missed* abortion. If it is causing no rise of temperature or other symptoms, it is generally left to be expelled, as it often is, at the date corresponding to the full term of labour. It ought, however, to be carefully watched, for any signs of intra-uterine sepsis should make the attendant at once adopt the treatment for incomplete abortion. At the same time, it is felt by some obstetricians that it is hardly scientific treatment to allow a dead gestation sac to remain in the uterus till danger arise; but, on the other hand, it must be remembered that it is usually an aseptic sac lying in a germ-free cavity with which one has to do, and that there is always some doubt as to the exact diagnosis.

### Accouchement Forcé.

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(a) <i>Manual and Bimanual</i> . . . . .	10	(e) <i>Vaginal Cæsarean Section</i> . . . . .	12
(b) <i>Hydrostatic Bags</i> . . . . .	11		

It is convenient to group together under the name *accouchement forcé* all the operations which have as their purpose the rapid and forcible enlargement of the cervical canal and the immediate extraction of the child. In this way—the plan adopted by Munro Kerr in his *Operative Midwifery* (pp. 454-476, 1908)—there are brought together under one heading the operations of manual dilatation of the cervix, of dilatation by hydrostatic dilators (metreurynters), tents, or expanding metal instruments, of enlarging the canal by means of incisions, and of vaginal Cæsarean section. The essential feature of the operation is the enlargement of the cervical canal, and this can be carried out, as above indicated, by one of two methods—stretching or cutting, dilatation or section; thereafter the choice is between forceps and version, for the extraction of the infant.

The *indications* for this operative procedure cannot as yet be clearly defined. A discussion, which had the delimitation of these various plans of artificially enlarging the cervix in labour as its object, took place in 1907 (*Brit. Med. Journ.*, ii. for 1907, pp. 426-431); but although many contributions of considerable value were made to the subject on this occasion, it cannot be said that the indications for accouchement forcé were then agreed upon, nor are they now. There is, however, a general feeling that certain grave cases of eclampsia justify the operation. When the cervix is taken up and the os somewhat open the manual and bimanual methods, the use of hydrostatic bags, and even the employment of the Bossi or other metallic dilator are to be recommended; but when the cervix is not taken up and the os is closed, vaginal Cæsarean section ought to be the operation of election. Grave eclampsia at the sixth month, therefore, may perhaps be regarded as the most undoubted indication for vaginal Cæsarean section, while the same disease coming on near to full term or in the early stages of labour will call for one or other of the dilating methods. In addition



to eclampsia in being, some obstetricians regard the threatening of convulsions as a sufficient indication for accouchement forcé; but the success of preventive means ought to be taken into consideration, and such measures ought at any rate to get a fair trial. Other indications, about which, however, there is no strong consensus of opinion, are accidental hæmorrhage (especially the concealed variety), some cases of placenta prævia (when the hydrostatic bags are generally chosen), hyperemesis gravidarum (although the prognosis is very grave), and serious cases of heart disease and of acute œdema of the lungs, which are not beneficially affected by medicinal means. Not only are there marked differences of opinion regarding the justifiability of the operation in these morbid states, but there are also divergent views regarding the methods to be adopted—some obstetricians, for instance, preferring the knife, others always using the fingers, and others favouring the bag or the Bossi dilator. On the whole, the tendency appears to be to restrict accouchement forcé more and more, and to limit especially the use of metallic dilators of the Bossi type.

Of the various *methods* proposed for the performance of accouchement forcé, we may refer first to *manual* or *bimanual dilatation* of the cervix. Harris (*Surg. Gynec. and Obstet.*, iii. p. 79, 1906) strongly supports the manual method, but points out that it is not suitable in cases of cervical cancer or when there is much cicatricial tissue in the cervix (previous lacerations). The patient is put under an anæsthetic, the rectum having been thoroughly emptied. The operator wears rubber gloves, and the patient's external parts are carefully cleansed. If the cervical canal will admit the index finger up to the metacarpophalangeal joint, then dilatation may be at once begun; if not, a metallic dilator must be used until the finger passes in. At first the under finger (flexed) and the tip of the thumb are pushed in; in from five to twenty-five minutes two fingers and the thumb can be got in; with these the cervix is gradually stretched, by expanding the fingers till three fingers and the thumb are within the canal; finally, four fingers and the thumb are introduced, first close together and later expanded, and so the canal is fully dilated in about forty-five minutes. When one hand tires, the other is employed; and great care is taken to keep the gloves aseptic. The bimanual method, as used by Edgar (*Practice of Obstetrics*, p. 925, 1903), is in some respects preferable to the unimanual. It also presupposes sufficient dilatation to admit one finger; and if this is not present, a metallic dilator or a plug of gauze must be inserted. The index finger of one hand is pushed in, then the corresponding finger of the other hand is introduced, and with the two back to back the cervix is stretched. "The pressure is continued as a sort of eccentric massage, the fingers of the opposite hands always making gentle and steady pressure outward and downward, and in opposite directions." The direction of the stretching force should be first antero-posterior, then lateral, and then oblique. When a second finger of each hand can be inserted, the dilatation is further effected until it is complete. The hands should even then be retained for some minutes in the cervix till complete relaxation is obtained. It is claimed for this method that it more closely resembles the natural process, that it keeps the membranes intact and does not interfere with the existing presentation and position of the foetus, that the sense of touch is retained, and that therefore the force used can be better estimated and laceration made less likely, and that, since the manipulation is intra-cervical only, there is less



risk of sepsis. Lewis (*Surg. Gynec. and Obstet.*, iii. p. 756, 1906) thinks that this method, when performed under due precautions with educated fingers and without undue roughness or care, should be very useful; and is of opinion that, even if it be performed by one who is inexperienced, there will be less risk than if metallic dilators were employed. It does not, however, seem to have been much used; possibly the long and tiring manipulation and the comparative slowness of the manual method have discouraged operators and driven them to instrumental methods.

Another plan is by means of *hydrostatic bags*. The introduction of the inelastic conical bag of Champetier de Ribes and of Pomeroy's new hydrostatic dilator (*Surg. Gynec. and Obstet.*, iii. p. 542, 1906) and others has stimulated fresh interest in this method (originally introduced many years ago by Keiller (1859) and R. Barnes. When the bag is placed in the vagina it is rightly called a kolpeurynter (*e.g.* Carl Braun's instrument), but when it is placed in and exercises pressure on the cervix it ought to be termed a metreurynter. A certain amount of cervical dilatation is presupposed. The bag is thoroughly disinfected, and is introduced (in the case of the Champetier de Ribes's instrument) folded together closely in the grasp of a special pair of forceps into the cervical canal; it is then partly distended by pumping water (lysol solution) into it by means of a syringe, and the forceps is unlocked and withdrawn. Since the broad end of the cone is uppermost, there is little tendency for the bag to slip out; it is now further distended with water and left to dilate the canal, although some operators recommend that traction (continuous or intermittent) be made on it to hasten the dilatation. It is not so rapid a method as manual dilatation, and of course it is much slower than vaginal Cæsarean section or Bossi's plan; but it is claimed for it that, forming as the bag does a fluid dilating wedge, it more closely resembles the natural process. J. B. De Lee (*Internat. Clinics*, 16 s. i. p. 147, 1906) states that the hydrostatic bag is, without question, the safest method of opening the cervix, and recommends the Voorhees bag, an American modification of the French style; he admits that if care is not used the uterus may be ruptured. The general opinion would seem to be that hydrostatic bags are finding their special sphere of usefulness in the modified accouchement forcé which is employed in the treatment of placenta prævia.

Had this summary been written two or three years ago considerable space would necessarily have been given to the discussion of Bossi's *metallic dilators* and of the somewhat similar instruments of Frommer, Tarnier, and de Seigneux (*Zentralb. f. Gynäk.*, xxix. p. 717, 1905); but less attention need now be given to this method of performing accouchement forcé, for it has been abandoned by many obstetricians. Bossi's invention of a branched metallic dilator consisting of three or four rods ending in blunt points, which could be accurately and equally separated by a registering screw apparatus at the bases of the rods, had much to do with the temporary popularity of this form of rapid dilatation (*viz.* 30 to 35 min.) of the cervix; and Leopold's strong recommendation (*Arch. f. Gynaek.*, lxvi. p. 198, 1902) quickly spread its fame abroad. Soon after the appearance of Leopold's article the instrument of Bossi was successfully employed in Edinburgh by Sir A. R. Simpson (*Trans. Edin. Obstet. Soc.*, xxviii. p. 21, 1902), by Frost (*ibid.*, p. 15, 1902), and by Ballantyne (*ibid.*, xxix. p. 76, 1903-4), generally in cases of eclampsia; Gairdner used either the Bossi or the Bossi-Frommer dilator in fourteen cases in Glasgow (*Journ. Obstet. and Gynec. Brit. Empire*, iv. p. 384, 1903); De Paoli



(*Arch. f. Gynaek.*, lxi. p. 12, 1903) treated nineteen cases of placenta prævia thus, with one maternal death; and Schürmann (*Monatsch. f. Geburtsh. u. Gynaek.*, xviii. p. 513, 1903) reported ten cases in which Preiss's modification of the Bossi was used, and thought that for abortions between the fourth and sixth month, and for labours at term, Bossi's plan was a great addition and a safe method. Ehrlich's lengthy article (*Arch. f. Gynaek.*, lxxiii. pp. 439-543, 1904) was more critical than any of the preceding contributions; this writer, from an experience of forty-seven cases in Leopold's clinique, thought that rapid mechanical dilatation of the cervix should be employed only when the life of the mother or of the infant was seriously threatened, that the earlier in pregnancy the plan was resorted to the greater was the care and foresight necessary, and that special precautions were needed for primiparæ and patients in whom the cervix was not taken up. The critical period thus ushered in was continued throughout 1905 and 1906, till Runge (*Berl. klin. Wochens.*, xliii. p. 1190, 1906) gave it as his opinion that in skilled hands the instrument could yield good results, but that very few practitioners should use it, and that it should never be employed when the cervical canal still existed. Dührssen's method (deep cervical incisions) and Bossi's plan were brought into sharp contrast and conflict in a series of articles which appeared in 1905 and 1906 (*Arch. f. Gynaek.*, lxxv. p. 247, 1905; *Zentralb. f. Gynäk.*, xxx. pp. 289, 417, 509, 748, 811); and within the past two years little has been heard in favour of the latter method, while the former has been strongly pressed. Bossi himself, however (*Gynaek. Rundschau*, i. p. 789, 1907), defends forcible dilatation of the cervical canal, and states that he has in no way altered his views during the past seventeen years since he first introduced the instrument that bears his name. Cortiguera also (*Journ. de méd. Paris*, 2 s. xix. p. 400, 1907) maintains that Bossi's method is far the best at our disposal at the present time; the dilator is easy to sterilise and to use; it acts quickly and dilates sufficiently; it is applicable even before the cervix is taken up; it causes no lacerations of any account; the hæmorrhage is scarcely more than in normal labour; and it is as quick and less dangerous than Cæsarean section. Yet, whilst these voices are heard in favour of Bossi's method, it can hardly be denied that general obstetric opinion is against it. The risks of serious cervical lacerations are real, even when cases are chosen with care and a proper interval of time allowed for the process of dilatation, and there are certain so-called indications for its use, *e.g.* placenta prævia, and the ordinary induction of labour where haste is not needed, which are regarded by nearly everyone as indefensible. Whether or not a small field of usefulness remains for the Bossi dilator the future must decide. Grave cases of eclampsia in which the cervix has been taken up, but in which the convulsions cannot be controlled in other ways, may possibly continue with advantage to be treated by emptying the uterus by this method. But, as Ballantyne (*Trans. Edin. Obstet. Soc.*, xxix. p. 99, 1903-4) pointed out, it is an "exceptional remedy for exceptional conditions." Its distal end is a powerful dilator; at its proximal end, therefore, must be a sensitive hand, an observant eye fixed on the indicator, and a brain alert to note the degree of resistance which experience has found to warrant continued dilatation. "It is an instrument to be worked with the head rather than the hand."

The performance of accouchement forcé by the knife may take the form of *multiple deep cervical incisions*, or that of *vaginal Cæsarean*



*section.* For both these methods obstetricians are indebted to Dührssen (see Winckel's *Handbuch der Geburtshülfe*, B. iii. t. i. p. 609, 1906), although Acconci's claim of priority has been accepted by some. Superficial cervical incisions are no novelty in obstetric practice; but *deep* incisions were first practised in a systematic way by Dührssen in 1890 (*Arch. f. Gynaek.*, xxxvii. p. 27). They were four in number—an anterior, a posterior, and two lateral, and they ran from the margin of the os to the utero-vaginal junction; they were made with a pair of angular scissors, and it was found to be advantageous to clamp the cervix with long catch-forceps on each side of the incision (De Lee, *Internat. Clinics*, 16 s. i. p. 147, 1906). The operation thus introduced has been frequently practised, more especially in cases of eclampsia and accidental hæmorrhage; it should be restricted to the cases in which effacement of the cervix has already been secured, and the incision should be closed with sutures immediately after the birth is completed. The danger is extension of the cuts during extraction, with consequent conversion of a cervical incision into a uterine rupture. Partly on this account, and partly for other reasons, Dührssen in 1895 described and recommended the operation of *vaginal Cæsarean section* or *vaginal hysterotomy* (to use a less ambiguous designation), and in 1896 published his work on the subject (*Der Vaginale Kaiserschnitt*, Karger, Berlin). Several years, however, elapsed before the operation was received with any favour; indeed, it was hardly known among English-speaking obstetricians till Stamm, in November 1903 (*Amer. Journ. Obstet.*, xlviii. p. 595, 1903), and Munro Kerr, in January 1904 (*Trans. Edin. Obstet. Soc.*, xxix. p. 68, 1903-4), introduced it to American and British practice respectively. But during the preceding years there had been several Continental contributions to the discussion regarding the value of and indications for this new obstetric procedure. Recommended at first in cases of cancer of the cervix uteri in pregnancy (Dührssen, *Zentralb. f. Gynäk.*, xxi. p. 942, 1897; Mittermaier, *ibid.*, xxii. p. 5, 1898; Seiffart, *ibid.*, xxii. p. 121, 1898; and others, *ibid.*, xxiii. pp. 572, 670, 816, 856, 1287; xxiv. pp. 69, 933, 1357, etc.), it was ere long extended to other morbid states, such as eclampsia, hyperemesis gravidarum, serious heart disease in pregnancy, and indeed to all those states in which rapid emptying of the gravid uterus was called for, and in which the cervix was undilated and not easily dilatable. In 1901, for instance, Dührssen (*Zentralb. f. Gynäk.*, xxv. p. 33, 1901) was using the vaginal Cæsarean section in eclampsia; in 1902 Jahreiss (*ibid.*, xxvi. p. 919) employed it in two cases of eclampsia; whilst Bumm (*ibid.*, xxvi. p. 1417, 1902) used it in chorea, nephritis, heart disease, eclampsia, cancer of the cervix, and for the induction of premature labour in thirteen cases, with one maternal death. Ehrendorfer (*Zentralb. f. Gynäk.*, xxvii. p. 483, 1903) employed it in hyperemesis gravidarum; Rühl (*ibid.*, xxvii. p. 1044, 1903) brought it into action in marked rigidity of the cervix; and further cases of eclampsia treated in this way were reported (*ibid.*, xxvii. pp. 488, 1367, 1903). It would, perhaps, more quickly have attracted the attention of obstetricians had it not been that about this time (1903) accouchement forcé by means of the Bossi dilator was highly favoured; perhaps, also, Dührssen did not practise moderation in the way he stated his arguments. But since 1903 no obstetric operation has been more extensively discussed. Thus the *Zentralblatt für Gynäkologie* for 1904 contained fourteen original articles by Rühl, Westphal, Ahlfeld, Dührssen, Kroemer, Steffek, Maly, Kermauner, Hammerschlag, Krönig, and Wanner; and its sphere was



extended so as to include placenta prævia. Uthmöller (*ibid.*, xxx. p. 306, 1906) performed the operation in private practice for eclampsia; and Zárte (*ibid.*, xxxi. p. 1625, 1907) did it for the first time in South America, the indication being laryngeal stenosis. In other countries contributions appeared from the pens of Webster (*Amer. Journ. Obstet.*, xlix. p. 810, 1904), Bacon (*ibid.*, l. p. 488, 1904), Jerie (*Casop. lek. cesk.*, xliii. p. 1168, etc., 1904), Miller (*New Orl. Med. and Surg. Journ.*, lvii. p. 551, 1904-5), Mainzer (*Deutsche med. Wochensch.*, xxxi. p. 266, 1905), Strauss (*Med. Rec.* (New York), lxxvii. p. 417, 1905), C. Van de Poll (*Med. Weekbl.*, xi. p. 575, 1904-5), H. D. Fry (*Surg. Gynec. and Obstet.*, i. p. 58, 1905), Fabre (*Lyon Méd.*, cvii. p. 604, 1906), Bar (*Rev. gén. de clin. et de therap.*, xxi. p. 769, 1907), Brewis (*Scott. Med. and Surg. Journ.*, xxi. p. 226, 1907), Karnicki (*Przegl. lek.*, xlvi. p. 471, 1907), Saks (*Medycyna*, xxxv. p. 644, 1907), and H. D. Fry (*Amer. Journ. Obstet.*, lix. p. 202, 1902). Indeed, had it not been for the discussion which arose in regard to pubiotomy, and which diverted obstetric interest in another direction, the operation of vaginal Cæsarean section might still have been the cause of much writing; as it is, it may be said that the sphere of its usefulness has now been marked out with a certain degree of definiteness. In early pregnancy, when for any reason the uterus requires to be emptied quickly, Dührssen's operation is by many regarded as the best means of so doing, for it is founded on sound surgical principles; but it requires considerable technical skill, and is emphatically the operation of the obstetric specialist (calling, as it does, for qualified assistants and the equipment of a hospital). Munro Kerr (*Operative Midwifery*, p. 476, 1908) is of opinion that up to the twenty-eighth week of gestation it is the best way of rapidly emptying the uterus; and there is much to be said in support of this conclusion if it be added that a skilled operator accustomed to vaginal surgery is available to carry it out. The indications for its performance would therefore be such morbid states as hyperemesis gravidarum, chorea gravidarum, and eclampsia before the seventh month. In the later months of pregnancy the vaginal operation does not seem so applicable, for the extraction of a full-sized child through the opening made for it by this route can hardly be safely accomplished, and damage to the lower uterine segment is to be anticipated. Munro Kerr, therefore (*op. cit.*, p. 476), would prefer the ordinary abdominal Cæsarean section for the cases in which Dührssen and his followers recommend the vaginal operation. It would appear also that the latter procedure is not suitable in placenta prævia; but it may be favourably considered in cases of cancer, and perhaps of myoma of the cervix and lower part of the uterus.

With regard to the details of the operation of vaginal Cæsarean section there have been some differences of opinion. As originally performed by Dührssen, it was customary to incise both the anterior and posterior walls of the vagina, and some operators still pursue this method; but it is now more usual (especially in the early months of pregnancy) for the incision to affect only the anterior wall, *i.e.* anterior hysterotomy. Further, Dührssen himself (*Berl. klin. Wochensch.*, xlvi. p. 194, 1909) has recently given his approbation to a new method devised by his assistant, Solms; this consists in a combination of gastro-elytrotomy (Ritgen) and vaginal Cæsarean section (laparo-colpohysterotomy), and really differs so much that it ought rather to be regarded as a new procedure altogether (Solms, *Berl. klin. Wochensch.*, xlvi. p. 199, 1909). Vaginal Cæsarean section, as usually performed, differs somewhat according to the age of pregnancy when it is carried out. If it be indicated in



early pregnancy, then the following method may be used (De Lee, 1906; Munro Kerr, 1908; Whitridge Williams, 1908). The patient is placed in the lithotomy position, and the usual thorough cleansing of the vulva is carried out. One skilled assistant gives the anæsthetic and another helps the operator; it is well to have a third, if possible, to prepare and hand ligatures, etc. A good light is essential, and a large speculum or retractor is needed to expose the cervix by pulling back the posterior vaginal wall. The cervix is then seized with two pairs of volsellæ and dragged down towards the vulva; strong heavy traction sutures (silk or gut) are then passed through the cervix on both sides to replace the volsellæ and maintain the uterus at its low level, thus giving more space for manipulation. A transverse incision is made across the cervix immediately below the reflection of the bladder, encircling the cervix in one-third of its circumference, and a longitudinal cut is next made, passing up to about 1 cm. from the urethra; both these incisions divide only the mucous membrane. The finger is then introduced through these incisions and the bladder pushed out of the way, and it is very important that this be done thoroughly; thus the pouch of peritoneum is displaced upwards and the anterior cervical wall is laid bare. The next step is the division of the anterior wall of the cervix with scissors and in the middle line; further traction is made and the lower uterine segment comes into view; this also is incised; and then, as a rule, the bag of membrane bulges through, is ruptured, and the child extracted by turning. The placenta and membranes are next stripped off and removed. A hypodermic injection of ergotine may have been given at the beginning of the operation; if not, it should be administered now. An intra-uterine douche (at a temperature of 116° or 118° F.) will now be found to be useful in making the uterus retract. The uterine wound is closed by a continuous catgut suture, beginning at the upper end of the incision and having the stitches close together. If the uterine cavity has been previously plugged with gauze, care will have to be taken that the stitches do not catch upon the packing. The vaginal incisions are next closed with catgut, but a thin strip of gauze may be placed in the vesico-uterine space (in front of the cervix) and withdrawn (along with the uterine plug) twenty-four hours later. It should be added that after the extraction of the child and placenta the re-insertion of the vaginal speculum and the making of traction upon the cervix will bring the field of operation fully into view and greatly facilitate the later stages of the operation. It may be necessary, according to Munro Kerr, to pull the uterus back and tack it into position before closing the vaginal incision. The whole operation is, as will have been noted, an extra-peritoneal one: the reflection of peritoneum in front of the uterus is pushed upwards and out of the way so as to give access to the anterior aspect of the supravaginal portion of the cervix and to the lower segment of the body of the uterus. If the operation is carried out in the later weeks of pregnancy it is generally recognised that some modification of the details is necessary. It is then necessary to incise the posterior wall of the uterus as well as the anterior. Thus Bar (*Rev. gén. de clin. et de therap.*, xxi. p. 769, 1907) makes an incision in the middle line in the posterior lip of the cervix, reaching the length of the vaginal *cul-de-sac* and extending for 4 cm. on to the vaginal wall; the peritoneum can be stripped off the posterior aspect of the cervix through this incision. Dührssen makes a vertical incision in the posterior lip of the cervix and a transverse one in the posterior vaginal



vault. Then the anterior incision is made. By this means both the anterior and posterior aspects of the lower uterine segment are exposed. Regnoli (*Policlin.*, xi. sez. chir., p. 49, 1904) makes the posterior incision, and limits the anterior one to the cervix. Döderlein (*Zentralb. f. Gynäk.*, xxxi. p. 1027, 1908) does not divide the vaginal fornix from the cervix and push up the bladder; he simply divides the uterine wall higher and higher, applies his forceps further and further up, and draws the uterus more and more downwards; the bladder and other structures separate themselves. The other stages of the operation are much the same as when the section is performed earlier; but it has been found, more especially if the patient be a primipara, that it is very helpful to do a preliminary episiotomy to give more room in the vagina for manipulation. Dührssen makes a right-sided vaginal and perineal incision, and if the levator ani be divided he is thus able to pass his whole fist into the vaginal canal and vault, pull the cervix down into view, and limit the hæmorrhage. After the extraction of the child and placenta, the posterior incision is closed first, preferably by through and through catgut sutures tied on the cervical mucous membrane; then the vagina is closed by a continuous catgut suture tied on the vaginal mucous membrane; next the anterior wound is sutured; and finally the perineal wound is secured. Of course the operation of vaginal Cæsarean section is not without its risks. The peritoneum may be opened into or the bladder may be wounded by extension of the incisions during extraction of the child, although some operators have never met with this (Bumm). There is danger of hæmorrhage from the incisions and from the placental site; but the head of the child acts as a plug during the operation, and the uterus can be packed with gauze afterwards. The downward traction which can be made upon the cervix also helps to check the bleeding. The danger of rupture of the uterus in subsequent labours would seem to be exaggerated. It may be stated, in conclusion, that vaginal Cæsarean section, in the hands of specialists, offers a rapid and reasonably safe method of opening into and emptying the uterus at any date in pregnancy, whatever be the state of the cervix; it may be anticipated that it will continue to be employed in a limited number of cases which can otherwise hardly be satisfactorily dealt with.

**Achylia Gastrica.**—A condition of permanent anacidity of the stomach described by Einhorn, in which the secretion of hydrochloric acid is in abeyance: according to some writers pepsin is also absent. The symptoms are variable; lienteric diarrhœa is the most characteristic. Gastric achylia occurs in many cases of carcinoma: apart from this, it is chiefly a disease of the senile period, and is probably often a complication of some underlying condition—cirrhosis, etc. The diagnosis of gastric achylia rests on an examination of the stomach contents. 1. During fasting the stomach is empty, and after an Ewald's test breakfast only a little undigested bread can be recovered—*i.e.* there is no stagnation of food in the stomach. 2. Gastric contents neutral, or faintly acid; no pepsin. 3. No gastric mucus after Ewald's test breakfast. 4. The gastric mucosa is fragile, and bleeds readily when a tube is passed.

REFERENCE.—LIEFSCHUTZ. *Arch. f. Verdauungsk.*, 27th October 1906.



**Acidosis.**

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THE condition known as acid intoxication, or acidosis, has assumed considerable importance during the past few years. While there is a belief, apparently well founded, that acid intoxication exists under a variety of different circumstances, and that it is at the root of several clinical groups of symptoms, it must be admitted that the only condition which has been definitely proved to be due to acidosis is diabetic coma. Next in importance and probability as clinical manifestations of acidosis, come the cyclic vomiting of children and delayed chloroform poisoning, while it is also possible that some forms of infantile atrophy are due to the same cause. Before, however, considering the symptomatology of the condition, it is necessary to discuss the general nature of acidosis.

We may define acidosis as a diminution of the normal alkalinity of the tissue juices from the presence of fatty acids and their derivatives, which are ultimately excreted in the urine as acetone, diacetic acid, and oxybutyric acid (*ketonuria*). Since, however, it is the retention, and not the elimination, of these bodies which causes intoxication, acidosis may occur without ketonuria, and *vice versa*.

**SOURCE OF THE ACETONE BODIES (KETONES).**—Of these, oxybutyric acid is that which is primarily produced in the body; by its oxidation diacetic acid is formed, and from this again acetone is derived. The acetone bodies are directly derived from fat—particularly the lower fatty acids, such as butyric acid. Carbohydrates and proteids give rise to them indirectly only in so far as they lead to the formation of body fat. The question then arises, are the acetone bodies normal intermediate products of fat metabolism, and is their development in the tissues in excessive amount due to a defect of secondary oxidation, or, are they due to abnormal metabolism of fat? The latter alternative seems the more probable. The immediate cause of the fat metabolism going astray seems in all cases connected with default of carbohydrate metabolism. It may be that the carbohydrate element of the food is insufficient (as in starvation), or that, as in diabetes and possibly other conditions, the body is unable to utilise what is eaten. In any case it is certain that for the complete oxidation of fat, carbohydrate must be burnt up in the body. This is perhaps one of the chief facts demonstrated concerning acidosis—that its immediate cause has to do with deficiency of carbohydrate. The acetone bodies are produced in the tissues of the body, particularly in the liver and muscles, not in the intestine, but further than this their seat of origin is unknown.

**EXCRETION OF THE ACETONE BODIES.**—In health the only member of the group which is eliminated is acetone, which is excreted in the expired air (·03 gram to ·08 gram per twenty-four hours) and in the urine (·1 gram to ·3 gram per twenty-four hours). Only when the urine contains larger quantities than this do we speak of a pathological “acetonuria.” As the amount of acetone in the urine rises, diacetic acid and oxybutyric acid also appear, but there is no constant ratio between them. The quantity of oxybutyric acid excreted often greatly exceeds that of the acetone. The excretion of the acetone bodies is greatly in-



fluenced by the administration of alkalies; large doses of sodium bicarbonate wash the diacetic and oxybutyric acid out of the tissues.

RELATION OF URINARY AMMONIA TO ACETONE BODIES.—An important connection exists between the excretion of ammonia and the acetone bodies. In man the greater part of the ammonia produced in the body is converted into urea, but a small proportion evades this transformation, and is eliminated in the urine in combination with the mineral acids set free from the food. The ammonia nitrogen normally forms only from 3 to 5 per cent. of the total urinary nitrogen. The object of this mechanism is to spare the fixed bases of the body. An increase in the mineral acids of the food increases the output of urinary nitrogen; organic acids, with the exceptions undernoted, have no such effect, as they are eliminated as carbonic acid. Lactic acid and the acetone bodies, however, behave like mineral acids in this respect, hence the amount of ammonia nitrogen in the urine is an index of the quantity of these substances (and therefore of acidosis) in the body. Each gram of ammonia excreted in excess of that present in the food is equivalent to 6 grams of oxybutyric acid. The administration of alkalies diminishes, and their withdrawal increases, the output of ammonia. While increase of ammonia nitrogen in the urine is most commonly brought about in this way, it may also arise from interference with the urea synthesis, such as occurs in liver diseases.

TESTS FOR THE ACETONE BODIES.—No simple clinical method for the quantitative estimation of acetone and oxybutyric acid is available. For the ordinary quantitative reactions of these bodies, see *Encyclopædia Medica*, Vol. XIII. p. 113. The most generally useful test for the presence of the acetone bodies is ferric chloride, which gives a port-wine colour with diacetic acid (not acetone). In slight degrees of acetonuria, therefore, when acetone alone is present, the reaction is negative. The test is not available when the patient is taking salicylate, as the urine then gives the same port-wine colour with ferric chloride.

CLINICAL.—Clinically, we must distinguish between acidosis and acid intoxication. An individual may suffer from acidosis for years, without any special symptoms arising. This occurs, especially, in diabetes. The main symptoms ascribed to acid intoxication in man are—dulness and apathy, increasing to drowsiness and coma; sometimes, however, these are preceded by restlessness, irritability, insomnia, and delirium. Vomiting, which may be uncontrollable, and is sometimes hæmorrhagic, associated either with diarrhoea or constipation, is a fairly constant symptom. The abdomen is sunken; thirst and epigastric pain are sometimes complained of. Icterus is not uncommon. There is every appearance of the gravest illness. The face has a dusky flush, the tongue becomes dry, the abdomen sinks, the pulse becomes feeble, and the patient is collapsed. A peculiar form of breathing, known as “air hunger,” characterised by deep, laboured respiration, is common. The breath smells strongly of acetone, and the urine generally gives a marked ferric chloride reaction. Not all these symptoms, however, necessarily occur in any one case. They may be grouped around five heads—nervous, gastric, respiratory, collapse, and excretion of ketones, and sometimes one, sometimes another series predominates.

It will be seen that in this varied symptomatology the clinical picture of acid intoxication departs to some extent from that produced experimentally in animals, and it is not quite certain that all the above symptoms are due exclusively to acidosis. The purest type of the con-



dition exists in diabetic coma, which responds, moreover, temporarily at least, to alkaline injections much more rapidly than do any of the others.

**TYPES OF ACIDOSIS AND ACID INTOXICATION.**—From a clinical point of view, we may group cases as follows:—1. Symptomatic acidosis. 2. Acid intoxication from drugs. 3. Diabetic acidosis. 4. Cyclic vomiting. 5. Delayed chloroform poisoning. 6. Acidosis in infancy. The different groups overlap to some extent, but in their leading features they are sufficiently distinct from one another.

1. *Symptomatic Acidosis.*—Acetonuria, accompanied or not by an odour of acetone in the breath, but not associated with any other symptoms which at present can be referred to acidosis, occurs in a great variety of conditions. It is met with in sepsis, acute pneumonia, fevers of all kinds, appendicitis, peritonitis, gastric ulcer, diphtheria, toxic gastro-intestinal disorders, starvation, and indigestion, especially in children. Its occurrence in these cases has been ascribed to organismal toxæmia and auto-intoxication, but the view held by most of those who have paid particular attention to the subject, is that in these, as in other cases, defect in the oxidation of carbohydrates is to blame.

2. *Acid Intoxication from Drugs.*—Among drugs which cause acidosis, phloridzin, morphine, and phosphorus may be mentioned. By far the greatest practical interest, however, attaches to the acid intoxication which may result from the administration of sodium salicylate, especially when the drug is given in very large doses. Air hunger is the first danger signal; it indicates a cessation of the salicylate and the free administration of sodium bicarbonate. Dr. Lees advises that twice as much sodium bicarbonate as salicylate should be given when the latter drug is being freely used, and that constipation should be treated. If these precautions are taken, serious intoxication is unlikely to occur.

3. *Diabetic Acidosis.*—The clinical features of diabetic coma are described elsewhere (*Encyclopædia Medica*, Vol. II. p. 489). It is easy to understand why a diabetic is specially liable to acidosis. He takes little carbohydrate, and cannot utilise what little he does take. The greater his intolerance of carbohydrate, the more certain is he to suffer from ketonuria; if, however, he can assimilate as much as 80-100 grams of carbohydrate per day, ketonuria will probably remain absent. The inhibition of ketonuria by carbohydrate depends, of course, not on the amount eaten, but on the amount catabolised. When the acetone in the urine amounts to about .5 grams per day, diacetic acid (shown by ferric chloride test) is generally also present. The ketonuria of diabetes, though on the whole similar to that of inanition, differs from it in the following particulars (Noorden):—1. A diabetic patient may tolerate starches in quantities which, in a normal person, would be enough to prevent ketonuria; yet, notwithstanding this, he may develop ketonuria. 2. In a diabetic a change from a mixed to a carbohydrate-free diet may cause ketonuria, which does not disappear when carbohydrates are again added to the food. 3. In other cases ketonuria disappears on a strict diet, on account of the improvement in the general condition. 4. Diabetic ketonuria varies, though the diet and catabolism of sugar remain constant; and different persons, on the same diets, and having identical powers of catabolising sugar, exhibit differences in the amount of ketones they eliminate.

4. *Cyclic Vomiting.*—This has only been recognised as a definite



clinical entity within recent years. It is also known as periodic vomiting, vomiting with acetonæmia, and food fever with recurrent gastric catarrh (Eustace Smith). It usually occurs in childhood, from the second or third year and onwards; it tends to cease spontaneously at puberty, when, it is said, it may be replaced by migraine. The attacks recur at irregular intervals of a few weeks or months. The vomiting, which is the outstanding feature, sets in suddenly, usually in the midst of perfect health. It is projectile, extremely severe and uncontrollable, the smallest quantity of fluid being at once rejected. With this vomiting the child looks extremely ill; he is at once prostrated, the eyes become hollow, the face has a dusky flush, the tongue is dry, and there is great thirst. The fruity odour of acetone is very evident in the breath, and there is usually also acetonuria. The attacks generally last for five or six days—rarely much longer; they are accompanied by very apparent wasting. The vomiting ceases as suddenly as it began, and there is, simultaneously, rapid improvement in the general condition. The appetite returns immediately, there is no sign of indigestion, and recovery is very rapid.

In another group of cases the clinical features are somewhat different. The patients are children who suffer from chronic indigestion, and are particularly intolerant of carbohydrates. They are liable to attacks of pyrexia, to urticaria, and to paroxysmal vomiting with acetonuria. Marked irritability of temper sometimes characterises the onset of a vomiting bout, or an attack of pyrexia. The parents of such children are often "gouty," and the patients themselves often suffer from gravel.

Cyclic vomiting may easily give rise to errors in diagnosis. It has often been mistaken for obstruction, and even operated on in that belief. The history, the odour of acetone, and the hollowed-out abdomen should prevent this error. The persistent vomiting and the retracted abdomen may also lead to a diagnosis of meningitis; here the history, the acetonuria, the absence of irregularity of the pulse, should lead us aright.

Cyclic vomiting is seldom fatal, hence there are few pathological records. It is, however, a curious fact that a relatively large number of deaths have occurred during a first attack of vomiting. However desperately ill the patient may appear, there is always room to hope that the vomiting will suddenly cease. Langmead describes the pathological appearances in four cases. The principal lesion found was well-marked fatty infiltration of the liver, and cloudy swelling, with some fatty change, in the kidneys.

5. *Delayed Chloroform Poisoning*.—Although this is described elsewhere (p. 26), it must be shortly referred to here. It is more commonly seen in children than in adults, and is especially liable to occur after laparotomy for any acute abdominal infection. The symptoms closely resemble those described above as characteristic of acidosis, and the post-mortem appearances, according to Guthrie and Langmead, are identical with what are found in cyclic vomiting.

6. *Acidosis in Infancy*.—In many infants suffering from gastrointestinal disorder, the urine contains a relatively large amount of ammonia nitrogen. Keller associates this fact with an excess of fat in the diet. As we have seen, increase in the output of ammonia nitrogen is a measure of acidosis. The excess of fat may lead to an increased absorption of fatty acids from the intestine—"absolute acidosis," or it may operate in another direction. According to Keller,



the fatty acids in the intestine are neutralised by the fixed bases of the tissues, which are found in the stools. The body is therefore despoiled of its alkali, and "relative acidosis" results.

It must not be supposed that the theory of acid intoxication is free from difficulties. Guthrie sums up the alternative hypotheses as follows:—

"1. That so-called fatty acid intoxication is due to deficiency of bases in the body to neutralise the acids formed, rather than to excess of the acids themselves.

"2. That diabetic coma, and therefore other cases attributed to fatty acid intoxication, are really instances of  $\text{CO}_2$  poisoning.

"3. That the toxic symptoms following anæsthetics are due to the anæsthetic remaining in combination with certain tissues of the body, or, in the case of chloroform, to its administration in too concentrated a form.

"4. That idiosyncrasy explains post-anæsthetic poisoning.

"5. That the symptoms are merely those of carbohydrate starvation (Beddard).

"6. That they are due to disturbance, not merely of fat metabolism, but also of the proteolytic, antitoxic, and glycogenic function of the liver (Hunter)."

At the present time, however, the acid intoxication theory, as outlined above, is both the best explanation of the phenomena and the best working hypothesis.

**THERAPEUTIC CONSIDERATIONS.**—The chief indications would seem to be to administer alkalis and carbohydrates. Alkalis have been extensively employed—on the whole with good results. In diabetic coma the manner in which intravenous injections of sodium bicarbonate sometimes restore consciousness is as striking a proof as could be desired of the essential nature of the condition; the improvement, unfortunately, is always merely temporary. In all cases of acid intoxication the attempt should be made to introduce large quantities of alkalis into the system—by the mouth, the bowel, or subcutaneously. When the stomach will retain it, sodium bicarbonate should be given in doses of 30 grs. or more at frequent intervals. For subcutaneous or (preferably) intravenous injection a 3-5 per cent. solution of the salt is used; when the drug is given by the rectum, from 120 to 480 grs. may be given in the day. If there is reason to suppose that chronic acidosis short of intoxication exists, alkalis should also be given regularly. Their effect in promoting elimination of the acetone bodies has already been mentioned. Joslin has recently suggested that since acidosis means a loss to the body of all the fixed bases, it is not enough to introduce sodium alone, and recommends the use of alkaline salts of potash, soda, lime, and magnesia.

Theoretically it would seem a simple matter to treat acidosis by giving carbohydrate. In acidosis from inanition or starvation the use of a starchy food undoubtedly brings about a cessation of the acetonuria. Except in diabetes, however, carbohydrates have not been much used in actual or threatening acid intoxication. Hunter suggests giving to patients about to be anæsthetised a well-sweetened meal three hours prior to operation. In acute acid intoxication, whether cyclic vomiting or delayed chloroform poisoning, the use of sugar or lactose does not appear to afford much benefit, but it seems reasonable to give them a trial, along with alkalis. Possibly levulose, which is more readily cata-



bolised by diabetes than other forms of carbohydrate, might prove useful in such cases. In the class of case described by Eustace Smith as "food fever," the line of treatment which has been found most satisfactory has been the limitation of the carbohydrate elements in the diet. This seems to point to such patients being unable to deal with carbohydrates in a normal fashion, and perhaps some inability of this kind is the factor which determines the occurrence of acidosis. Noorden points out that many diabetics can assimilate more starch when only one variety is given than when the diet contains mixed carbohydrates, and has introduced an "oatmeal cure" based on this fact (see DIABETES). A similar line of treatment seems worthy of trial in children with defective power of dealing with carbohydrates. Among "antiketogenous" substances which may, to some extent, replace ordinary sugars and starches, Noorden enumerates albuminates, pentoses, glyconic acid, glycerin, citric acid.

FATS. — Seeing that the acetone bodies are derived from fats, should these not be withdrawn from the food where acidosis is feared? Apparently little is gained by doing this. The giving of fats does not increase fat catabolism; it only leads to the food fat being catabolised instead of the body fat. Only the lower fatty acids, especially butyric acid, have a marked effect in increasing ketones, so that practically the chief matter is to restrict the intake of butter and cream. In the acidosis of infants the indication is to reduce the ration of milk greatly, and to give malted and unmalted starchy foods.

In addition to these causal indications, the symptoms of acid intoxication require treatment on the ordinary lines.

LITERATURE.—VAN NOORDEN. *Metabolism and Practical Medicine*, English edition, edited by Walker Hall, London, 1907, vol. i. p. 169; vol. iii. pp. 586, 882.—JOSLIN. *Trans. Assoc. Amer. Phys.*, 1907, xxii. p. 246.—FOLIN. *Idem*, p. 256.—GUTHRIE, SPRIGGS. *Brit. Med. Journ.*, 1908, ii.—LANGMEAD. *Brit. Med. Journ.*, 1907, ii. p. 820.—BEESLY, *Brit. Med. Journ.*, May 19, 1906.

**Acromegaly.**—SURGICAL TREATMENT.—There are now on record a number of cases where acromegaly is said to have been cured by surgical means. The procedure adopted has been to remove the tumour of the pituitary gland, which is so constantly present in this disease. The function of the pituitary gland has been carefully investigated in recent years by Schaeffer, Herring, and others. The function which its secretion subserves is not yet understood, but it would appear that it is intimately concerned with growth and development. When this is the case it is not surprising that disease of the pituitary gland should so frequently be associated with gross malformation of the osseous and other tissues. The successful removal of tumours of the pituitary gland by surgical operation in cases of acromegaly has been attended by so pronounced an improvement in the patient's condition that it can now be considered as definitely proven that in many, if not all, cases of acromegaly the cause is to be found in an aberrant function of the pituitary gland.

Von Eiselsberg, of Vienna, was one of the first to obtain a successful result after operation in cases of acromegaly. One of his cases was that of a patient of thirty-three years of age. It showed the typical features of acromegaly. Eight years prior to operation she noticed, while pregnant, enlargement of the hands, feet, and face. She had previously suffered from headaches and visual disturbances. X-ray examination revealed a considerable enlargement of the sella turcica.



An operation for the removal of the tumour was undertaken at the patient's request. A solid growth was found involving the pituitary, which proved on examination to be of the nature of a sarcoma. The patient died two days after operation, from meningitis.

The method adopted by von Eiselsberg for obtaining access to the pituitary gland is one where a nasal flap is made, and access gained by the removal of the wall of the frontal sinus.

Hochenegg, of Vienna, has recently operated on a patient who was thirty years of age, and in whom the diagnosis of acromegaly had been made. The Röntgen-ray photograph of the skull showed a tumour of the pituitary to be present. The disease first appeared when the patient was aged fifteen years. At first, intense headache and periodic attacks of perspiration and epistaxis were complained of. This was followed by defective vision. At twenty-five years of age a marked improvement took place in the patient's condition. This was, however, followed later by a return of the disease in a more aggravated form. Enlargement of the hands and feet now developed, and marked thickening of the lips and face appeared. She was operated upon after the method of von Eiselsberg. A nasal flap was made, the nose turned back, and the hypophysis by this means exposed on chiselling through the sella turcica. The neoplasm was removed by means of the curette. It was found to be, on examination, an adenoma. The patient made an excellent recovery; the headaches disappeared, the eyesight became much improved, the hands and feet are said to have become much reduced in size.

The pronounced improvement that followed the removal of the pituitary tumour in this case is strong evidence in support of the growth having been responsible for the acromegalic condition.

**Adrenal Glands.**—Hutchison (*Quarterly Journ. of Med.*, Oct. 1907) directs attention to the existence of a definite clinical syndrome occasionally met with in children, viz. suprarenal sarcoma with metastases to the skull. He gives the following epitome of the symptoms, based on ten cases:—The ages of the patients varied from nine months to nine years. In most cases the first thing noticed was swelling of the bones of the skull, with proptosis, and sometimes ecchymosis of the eyelids. Anæmia is a striking feature, the blood picture being that of secondary anæmia, without leucocytosis. An abdominal tumour in one or other loin was felt in five cases. The progress of the disease is rapid—one to six months—and is marked by advancing exhaustion and anæmia, signs of increased intracranial pressure, optic neuritis, and blindness. The tumours of the skull increase in size, fill up the temporal fossæ, and give a very characteristic appearance. Post mortem, there was found in all cases a sarcoma of one or other suprarenal with metastases to the skull bones, ribs, and vertebræ, but not, as a rule, in the long bones, and only exceptionally in the viscera. The disease simulates scorbutus with orbital hæmorrhage, and chloroma (*q.v.*). In either case the differential diagnosis is easy—failure of antiscorbutic diet, and absence of lymphocytosis. While the condition is usually described as a sarcoma, it is possible that some cases are really malignant hypernephromata, which are more closely allied to carcinomata.

Precocious obesity, with premature development of the sexual organs, has been described by Bulloch and Sequeira, Guthrie, and others, as an accompaniment of hypernephroma (*Trans. Path. Soc. Lond.*, 1905; *Rep. Soc. Study Dis. in Children*, vol. vi., 1906; vol. vii., 1907).



Tilerton and Wolbach (*Amer. Journ. Med. Sci.*, June 1908) divide cases of suprarenal sarcoma into four categories:—(1) Those with metastases to the skull (Hutchison's type). (2) Simultaneous of liver and adrenals. (3) Those associated with precocious maturity. (4) Those not falling under any of the preceding heads.

**Alcoholism.**—QUINQUAUD'S SIGN.—This is a phenomenon which, particularly in Germany, has been the object of study to a greater extent than its importance merits. It was originally described by Maridort in 1900; his attention had been drawn to it by Quinquaud seven years earlier. Quinquaud's sign, which was at one time expected to afford a means of detecting alcoholism, is elicited thus:—The patient allows his outstretched fingers to rest lightly on the palm of the observer's hand at an angle of about  $45^\circ$ —in the position assumed in playing the piano. After a few seconds the observer can feel a sort of crepitation, as if the phalanges of the patient were knocking against one another. The crepitations can be heard if the patient's fingers rest on a small resonator—a box made of thin wood—to which the chest-piece of the observer's stethoscope is applied. Unfortunately, Quinquaud's sign is not pathognomonic of alcoholism: it is common in alcoholics, fairly frequent in moderate drinkers, rare in abstainers. Fürbinger states that if it is well marked the patient is probably a drunkard; if absent, alcoholism is excluded. According to Minor, it is very common in tabes—a “hypotonic phenomenon.” Lautscher looks on the sign as evidence of general nerve instability, and common in alcoholism. The mechanism of the sign is unsettled; some have regarded it as a crepitation of osseous surfaces on one another from fibrillary contractions of the interossei; others think it is produced in the tendon sheaths. Statements as to its relation to tremor vary; some assent, and some deny, an association between the two.

REFERENCES.—FURBINGER. *Deutsche med. Wochensch.*, 1904, No. 27; *Berl. klin. Wochensch.*, May 22, 1905.—MINOR. *Ibid.*, 1907, Nos. 18, 19, 20, 21.—LAUTSCHER. *Ibid.*, 1906, Nos. 34, 35.

**KORSAKOFF'S PSYCHOSIS.**—This is a peculiar symptom-complex which is most commonly associated with alcoholic peripheral neuritis, but may occur apart from neuritis, and may also result from other intoxications, *e.g.* chronic lead and arsenic poisoning, infectious diseases, or from senile arterial changes. It may be preceded by delirium tremens, or by alcoholic stupor. The four cardinal mental symptoms are (1) poor retention—inability to impress passing experiences on the memory; (2) defective memory for recent events; (3) disorientation in time and space; (4) and confabulation. Owing to the memory defect actual events are hopelessly mixed up and described in erroneous sequence and connection, leading to rather fantastic stories. The patient's memory has awkward gaps in it, and he advances ingenious fabrications to bridge over these, and to supplement the defects (confabulation). Notwithstanding the disorientation in time and space, the patient reacts fairly well to the immediate surroundings. Korsakoff's psychosis is much more common in women than in men.

REFERENCES.—CHAPIN. *Rev. Neur. and Psych.*, 1907, vol. v. p. 172.—BONHOEFFER. *Allg. Zeitsch. f. Psych.*, Sept. 2, 1904.



**Anæmia, Pernicious.** (See also, LEUKÆMIA, *Leukanæmia*).

—Hunter has elaborated his theory of the toxic nature of pernicious anæmia, and has described as characteristic of the disease a peculiar condition of glossitis. He regards this as one of the initial lesions, and associates it with exposure to drain infection. Hunter's observations have not, however, been generally confirmed. From a careful study of the morbid changes in a large series of cases Gulland and Goodall have arrived at the following general conclusion:—Pernicious anæmia is essentially a megaloblastic anæmia. The evidences of blood destruction throughout the body are so widely spread as to indicate rather a generally increased vulnerability of the blood-cells than a pathologically excessive hæmolytic action on the part of so many tissues. In some part of the body, not necessarily the intestine, a toxin is produced which acts directly on the marrow, interfering with normoblastic blood formation, leading to megaloblastic formation, and exerting negative chemotactic influences on the leucocytes. The megaloblastic degeneration is a reversion to the foetal type.

**TREATMENT.**—The X-rays having proved useful as a palliative remedy in leukæmia, have also been employed in pernicious anæmia. The reports which have been published are by no means encouraging, and it seems probable that the rays are as likely to do harm as good in pernicious anæmia. Byrom Bramwell advises that in the event of arsenic arresting the disease and producing a certain degree of improvement, a course of iron should be given. He records ten striking cases in which the administration of iron after arsenic was attended with marked improvement.

**APLASTIC ANÆMIA.**—Although this form of anæmia was described by Ehrlich in 1888, little attention has been paid to it until recently. It may be defined clinically as a severe form of pernicious anæmia which progresses steadily downwards without any of the remissions which are so characteristic of the ordinary type of the disease.

The individual symptoms differ in no respect from those of any severe anæmia, but the blood picture diverges more or less from what is generally considered characteristic of pernicious anæmia. There is a marked fall in hæmoglobin, red corpuscles, and leucocytes; the red corpuscles show the ordinary deformation, but megalocytes and nucleated red corpuscles are entirely, or almost entirely, absent, and the colour index is low. There is leucopenia, with relative lymphocytosis. When the absolute number of the different varieties of white cells is counted it is found that the diminution in the total is due to the small number of polynuclears. From the absence of nucleated reds and the diminution of polynuclears, it may be inferred that the marrow is inactive, and, in fact, such is the case. Instead of the red jelly-like marrow which is characteristic of pernicious anæmia, the marrow in aplastic anæmia is pale yellow and shows no sign of regeneration.

The cause of aplastic anæmia is unknown; for the present it seems best to classify it as a variety of pernicious anæmia. The recognition of the existence of such a group of cases is practically important, because the prognosis is much worse as regards the duration of life than in pernicious anæmia, and a case in which the above blood picture is observed must always be looked upon with anxiety.

**LITERATURE.**—HUNTER. *Lancet*, 1903, i. pp. 283, 367.—GULLAND and GOODALL. *Journ. Path. and Bact.*, Jan. 1905. **APLASTIC ANÆMIA.**—HIRSCHFELD. *Berl. klin. Wochenschr.*, April 30, 1906.—LAVENSEN. *Amer. Journ. Med. Sci.*, Jan.



1907, and *Trans. Assoc. Amer. Phys.*, 1906, vol. xxi. (with discussion). TREATMENT.—  
 BRAMWELL. *Brit. Med. Journ.*, Jan. 23, 1909.

## Anæsthesia and Anæsthetics.

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IN recent years there has been witnessed a profound alteration in the methods of inducing anæsthesia during surgical operations. The reason of this lies in the perfection which has been obtained in the practice of methods of local and regional anæsthesia.

### GENERAL ANÆSTHETICS.

Under this category chloroform and ether still maintain their position as the anæsthetics of choice in major surgical operations, and nitrous oxide and ethyl chloride are the drugs most depended upon when anæsthesia of short duration is required. The trend of popular opinion as to the relative merits of chloroform and ether has altered considerably of late in favour of the use of the latter, and this is especially to be noted in the home of chloroform, the Edinburgh Medical School. In spite of much advice from without, and of occasional alarming experiences within, the graduate of that School held to the opinion expressed by Lister in 1870, "that the danger of chloroform may be compared not inaptly to that of railway travelling. In both cases the risk incurred by any individual is so small that it does not enter seriously into our calculations, and just as railway accidents are generally occasioned by culpable mismanagement, so death from chloroform is *almost invariably* due to faulty administration." The explanation of the alteration lies, not in the discovery of new dangers during the actual administration of the drug, but in the revelation of risks more remote, and to which the term "delayed chloroform poisoning" has been given.

*Delayed Anæsthetic Poisoning—Delayed Chloroform Poisoning.*—Up to within a few years ago it was generally considered that, though the use of chloroform might give rise to a certain increased degree of responsibility to the operating surgeon during its administration, he was compensated for this by the knowledge that the complications to which it might give rise at a later date were less serious than was the case when ether was the anæsthetic. According to certain observers, however, this appears not to be correct, and especially in those cases where sepsis is present, the use of chloroform is attended with an increased amount of danger.

Delayed chloroform poisoning has been investigated in this country, more especially by Guthrie, Stiles, and M'Donald. In 1894 Guthrie published an article on "Some Fatal After-Effects of Chloroform on Children," and in it he drew attention to a class of case, the clinical characteristics of which were usually pronounced and the pathological features distinct, but the actual cause of death somewhat obscure. The cases all possessed the factor in common that operations under chloroform had been performed. In the majority the operation had been one of no undue severity, but instead of making a rapid recovery the child



developed acute delirious mania, uttering shrill, piercing screams at short intervals. Its eyes were dry, the pupils often dilated; its face usually was flushed, but in some cases pronounced pallor was noticeable. In certain of the cases these symptoms came on directly after the child had been returned to bed; in most they were not noticeable until the evening, and the child was observed to be restless and sleepless and often in a state of wild terror and anxiety. The temperature, which had been subnormal after the operation, had usually now risen to from 101° to 103° Fahrenheit. Consciousness was lost early, and at intervals the child was dull and apathetic. Grating of the teeth was present in some cases. A salient feature of the condition was the occurrence of extremely violent, persistent, and copious vomiting. This vomiting occurred even when the child was fed by the rectum. At first, food was returned from the stomach, and thereafter a clear or yellowish fluid, and this in most cases was succeeded by a vomit having the appearance of the dregs of beef-tea. This last Guthrie considered to be specially characteristic of this disease. Only in a very occasional case could it be described as having a "coffee ground" appearance. Death, preceded by coma and exhaustion, usually occurred within from one to nine hours. The type of breathing was like that which is common in cases of death from gradual respiratory failure. The inspiration was spasmodic, irregular, and gasping, with gradually increasing intervals between the acts, until the last breath was drawn; while expiration throughout was ineffective and attended by little or no action of the extra expiratory muscles. The pathological examination of the organs after death in these cases showed evidences of the widespread operation of an intense poison, as manifested by the degeneration of the parenchymatous tissue in many organs. This was especially observed in the liver, where an extreme degree of fatty degeneration was constantly present. The kidneys usually showed a similar appearance, but less pronounced in degree. The heart in certain of the cases showed fatty degeneration of its muscle fibres. No other pathological finding was at all constant. The most careful examination failed to detect the presence of sepsis or fat embolism. There was also no evidence that death had been caused by the absorption of any of the various antiseptics used during the treatment, such as carbolic acid or iodoform.

The ultimate conclusion to which Guthrie was driven as to the cause of death in these cases, was that it was due to the after-effects of the chloroform. He was unable to account otherwise for the fatalities than by supposing that the deaths were due to auto-intoxication, that the fatty degeneration of the liver existed before the operation, that chloroform and operation shock combined aggravated the functional disturbance already present, and thus loaded the system with toxic alkaloids, which the kidneys in certain cases were unable to eliminate. Guthrie, therefore, advised that in no case should chloroform be given to a patient suffering from fatty liver, and, as it is impossible, from physical signs and symptoms, to do more than surmise the existence of the same, we must rely on signs of functional inactivity of the liver as indicated by the excess of alkaloidal substances present in the urine. The precise nature of such alkaloidal substances, and the best method of detecting them, must be left for further investigation.

Little has been added to the clinical picture as described by Guthrie. It is now known that the disease is virtually associated constantly with the presence of acetone in the urine; and cases have been observed where the onset has been more gradual and the progress slower. All



observers confirm the constancy with which the characteristic "beef-tea" vomiting occurs. Stiles and M'Donald lay special emphasis on this, and suggest that the persistent chloroform sickness present after operation in certain cases may be a minor manifestation of the same condition. "Every surgeon who has closely watched patients after operations in cases of acute appendicitis, and occasionally after operations performed during the quiescent period, must have observed the critical condition in which he occasionally finds his patient about forty-eight hours or so after the operation. The chloroform sickness has persisted, the vomited matter is of the dark hæmorrhagic type already referred to, the patient has become rapidly emaciated, the pulse is small, rapid, and often irregular. There is sleeplessness, often extreme restlessness, and the patient is threatened with death from collapse. The urine contains a trace of albumen. There is no complication indicated with the wound, no pain, no increase of tenderness, and no distension. Nevertheless the patient is in a very critical condition, and the surgeon fears either general toxæmia or the commencement of a spreading peritonitis. Should no improvement set in, the surgeon will probably deem it necessary to open up the wound and investigate the deeper parts. He may find nothing wrong at the site of operation, and after adopting certain therapeutic measures, he is relieved to find that, during the next twenty-four hours, the patient's condition may have improved to such an extent as to call for no further anxiety. What is the exact cause of the symptoms in these cases? Are we dealing, though in a milder degree, with the same acute fatty degeneration changes that we can demonstrate as having occurred in the fatal cases, and if so, what share has the chloroform taken in bringing them about?" If it can be proved that in infective conditions, such as that above referred to, chloroform may so supplement the harmful action of the bacterial toxine as to be responsible for death, the question of substituting some other anæsthetic is obviously indicated. Beesly, when resident surgeon under Mr. Stiles, carried out certain most valuable observations on post-anæsthetic acetonuria. He confirmed the occurrence of the presence of acetone in many different diseases. A certain degree of acid intoxication occurs after every surgical operation in which a general anæsthetic is administered. With chloroform, varying degrees of poisoning are met with, from the slightest manifestation to the case of death from delayed anæsthetic poisoning. Acetone may be looked upon as being virtually constantly present in cases where sepsis has occurred; the administration of an anæsthetic may alter the normal elimination of this, and aggravate the clinical symptoms of intoxication. When ether was substituted for chloroform as the anæsthetic in cases where acute suppuration was present, the result of the change was claimed to prove that the previous mortality had, to a certain extent, been dependent upon the use of chloroform. Out of nineteen cases of acute appendicitis operated on under chloroform, fourteen died. Out of twenty-four cases operated on under ether, only two died.

Experimental evidence of the damage done by chloroform when administered as a general anæsthetic was first clearly demonstrated by Ungar and Junkers in 1883. They were the first to demonstrate that fatty degeneration can be produced by chloroform when administered by inhalation. Since then numerous other investigators have confirmed this observation. It has been found impossible, however, to reproduce with any degree of constancy the same clinical features and pathological



appearances with which delayed chloroform poisoning in man is associated. The reason of this, according to Stiles and M'Donald, is to be found in the fact that the fundamental cause of the death lies in a personal idiosyncrasy to the drug which is possessed by the patient. Guthrie, in his most recent article, emphasises the fact that the symptoms of so-called delayed poisoning by chloroform, ether, or ethyl chloride are those of acute fatty acid intoxication. The fatty acids which produce symptoms, viz. B. oxybutyric and diacetic acid, which are the poisonous precursors of acetone, are themselves the result of insufficient oxidation or imperfect metabolism of fat. Fat in excess must be present somewhere, in order to give rise by its imperfect metabolism to fatty acid intoxication. The liver, being the chief seat of metabolism of fat, must naturally be the chief organ suspected. All, or nearly all, the diseases and conditions under which operations followed by fatal symptoms of acetone poisoning have been performed, are those which are known to be associated with fatty liver. Causeless vomiting in a child would, according to him, justify postponing an operation. When the patient is suspected to possess a fatty liver, diet restricted in fat should be given for some days. Such fatty acids as may be present are best neutralised by the administration of bicarbonate or citrate of soda. Mild purgation is also beneficial. As starvation will give rise to acute acetonuria, nutrient enemata should be given two hours before, and immediately after an operation. (See also ACIDOSIS.)

*The treatment of post-operative intoxication* should be, according to Guthrie, by venesection, saline transfusion, and the administration of bicarbonate of soda. This may be given either by rectal injection or subcutaneous infusion.

*Narcosis Anæsthesia.*—The most convincing proof that can be obtained of the advantages of the induction of narcosis, prior to the administration of a general anæsthetic can be observed when chloroform or ether, especially the former, is given to an animal, such as the dog. When endeavour is made to anæsthetise the unnarcotised dog, a dangerous and most unpleasant performance is witnessed, for when the violent struggling of the animal is past, frequently it is found that a state of suspended animation culminating in death follows. When, on the other hand, a hypodermic of morphia is given, one hour prior to the giving of the anæsthetic, the animal is found to pass quietly under the influence of the drug, and even chloroform proves with such animals the safest of anæsthetics.

The induction of narcosis by the hypodermic administration of morphia prior to the giving of an anæsthetic has been practised for long, especially in cranial surgery. Recently this method has been more widely used, and with morphia there has been associated another drug—scopolamine—which antagonises certain of the more harmful effects of morphia, and at the same time augments its beneficial action.

*Scopolamine-Morphine Anæsthesia.*—Scopolamine is a drug that belongs to the atropine tropene group. The greatest drawback to its use is the inconstancy of the purity of the drug, and its liability to undergo decomposition. Kobert found that scopolamine, when applied to the cortex of the brain, diminished its electric irritability. It was in cases where pronounced cerebral irritability was present that it was first used in surgical operations by Schneiderling, the originator of this form of narcosis. The value of the combination of scopolamine and morphine consists in the cumulative hypnotic action on the cerebral



centres. They thus possess in combination a pronounced hypnotic action, but in other respects they are antagonistic in their action.

Scopolamine-morphine anæsthesia has now been practised for some years. It is usually given in combination with a general anæsthetic, and has proved eminently safe and satisfactory. Thus Grim reports 2850 cases in which they were given prior to the administration of chloroform and ether, without any bad effects following. He found the number of cases of pneumonia following operation was reduced to one-third of what had previously been his experience.

*Method.*—The method of administration may be carried out as follows:—As the drug rapidly deteriorates, it is advisable that the mixture be freshly prepared prior to administration. Where cases in which this form of anæsthesia is to be practised are often coming under treatment, a stock solution may be prepared and kept for four or five days. In order to prepare this stock solution, it is advisable that some preparation, such as Merck's Scopolamine, be used. A half grain of the alkaloid should be dissolved in 100 c.c. of sterilised water. From this 4 c.c. is placed in a sterile ampoule, and to this is added .033 grams, that is  $\frac{1}{2}$  grain, of sulphate of morphia. Each bottle thus contains  $\frac{1}{50}$ th grain of scopolamine and  $\frac{1}{2}$  grain of morphine. Two-and-a-half hours before the operation, one-third of the contents of the phial is given hypodermically. A like amount is given one-and-a-half hours before the operation. In the meantime, the state of the patient is carefully watched. If the pulse is regular, the respiration rate not unduly reduced, and the patient soundly asleep, the second dose may be omitted. In many cases, however, it is found advisable to administer the third portion half an hour before the time of operating. The patient is thus admitted to the operating theatre in an unconscious or semi-conscious condition. The preparation of the skin can usually be done without rousing the patient. If this should cause restlessness, the general anæsthetic is commenced at once. In administering the anæsthetic, the pupil is found usually to remain contracted. The amount of anæsthetic required is very much less than would be the case in the unnarcotised individual. Among the other advantages of this form of anæsthesia, there may be mentioned the obvious benefit of admitting the patient to the operating theatre in an unconscious state. Mental and physical excitement are thus absent. The patient also, when returned to bed, usually sleeps for an hour or more. Post-operative vomiting occurs less frequently. The drugs have also this advantage, that, when ether is administered, there is no hypersecretion of mucus to obstruct the air-passages. In many cases this method of inducing anæsthesia is found to be simple and satisfactory, but occasionally a case occurs where, probably from some personal idiosyncrasy to the drug, difficulty is experienced in bringing the patient under its influence.

*The Psychological Effect of Anæsthetics.*—Mention has already been made of the value of administering a narcotic prior to giving a general anæsthetic. The value of quieting the state of mental perturbation into which many patients are thrown can be easily realised and appreciated, but it is difficult to bring forward definite proof of this fact. Crile, in an article upon the "Psychic Factor in Graves's Disease" provides such a proof very clearly. From facts observed clinically, and from evidence obtained from experimental investigation, he submits the hypothesis that in Graves's disease the most powerful factor producing hyperthyroidism is psychic excitement. In some way, either directly



or indirectly, this leads to the discharge into the circulation of an excessive amount of thyroid secretion, which in itself may cause death. According to him, the greatest factor in the mortality, when such cases are treated surgically, is not the operation, but what has occurred prior to this. In other words, at the time the surgeon makes his first incision, the fate of the patient has been already decided. When Graves's disease is to be treated by surgical operation, this should be performed virtually without the patient's knowledge. The gland should be "stolen." In order to do this, Crile has devised a procedure which consists of a deliberate deception of the patient as regards the nature of the treatment to be undergone. On the evening prior to the operation, bromides are given; in the early morning, if the conditions are favourable for operation, a hypodermic of morphia is administered. When under its influence, ether is administered, the patient having been previously trained to believe that this procedure is part of a medical treatment. The operation of removing a part of the gland is then carried out. As a result of eliminating the psychic factor from the risks incidental to the surgical treatment of this disease, the author claims to have obtained a much higher percentage of recoveries.

#### REGIONAL ANÆSTHESIA.

*Local Anæsthesia.*—Local anæsthesia is now very widely practised, and the results obtained are found to be almost uniformly successful. It is an extremely safe method of inducing analgesia, and can be used in a wide variety of surgical operations. The uniform success which now attends its use is due to a variety of factors. The most important of these is the addition of the active principle of the suprarenal gland to the fluid infiltrated into the tissues. Braun was the first to use this substance in combination with cocaine as a local anæsthetic. Its presence causes contraction of the blood-vessels, and thus a smaller dose is required, the drug being localised, and its action intensified and prolonged in consequence. There would also appear to be evidence that, when it is ultimately absorbed into the general circulation, it has been changed into an innocuous compound. The result is that the amount of the anæsthetic required is considerably less when adrenalin is used, and the amount that can be given with safety is much greater. Another factor which has contributed to the success which has attended the practice of local anæsthesia in recent times is the much greater degree of dilution in which the fluid is used. As early as 1891, Schleich pointed out that it was possible to produce a very complete degree of analgesia if the tissues were thoroughly infiltrated with a cold, neutral, salt solution, and when given in such a manner the anæsthetic properties of such drugs as cocaine were greatly intensified. It is now customary to administer the anæsthetic dissolved in physiological salt solution. The advantage of injecting an isotonic fluid is that no irritation is caused, and the process is usually rendered absolutely painless. Braun has demonstrated that, when fluid such as distilled water is injected, this may be accompanied by a marked irritation of the part, even resulting in local necrosis. Probably also, to a certain extent, the increased success with which anæsthesia can now be induced locally is to be attributed to the use of certain drugs, such as novocaine, which are less toxic than cocaine. Novocaine is one of the more recent substitutes for cocaine which have been introduced



as a local anæsthetic. It is obtained in the form of a crystalline powder, which may be heated to a temperature of  $120^{\circ}$  C. without decomposition, and melts only at  $155^{\circ}$  C. It is soluble in its own weight of cold water, and the aqueous solution is isotonic with human fluids, and in more dilute solutions it can be made up in normal saline solution. Novocaine is said to possess as great anæsthetic potency as cocaine, whereas the toxicity of it is extremely slight. It also would appear to be almost devoid of any irritating action on the tissues.

Local anæsthesia may be practised either by (1) directly infiltrating the drug into the part to be operated upon, or (2) by investing completely the area to be operated on by peripheral infiltration. Both of these methods give very satisfactory results. The latter is now being very widely practised, and by means of it many operations can be most successfully performed. Thus large skin grafts may be removed from the front of the thigh, a finger may be amputated by infiltrating the base of the digit, and so on. It possesses the advantage that there is no risk of disseminating infection by it, or of devitalising the site of the wound.

*Technique.*—If novocaine be the local anæsthetic to be used, this may be obtained either in powder or tablet form. In the case of the surgeon who is practising local anæsthesia at all frequently, it is advised that he obtain it in the form of a powder, and make up his own stock solutions from that. The stock solutions necessary are (1) a 1 per cent. solution of novocaine, made by dissolving 1 gram of the powder in 100 c.c. of normal saline solution; (2) a solution of sterile physiological salt solution, made by dissolving .9 gram of sodium chloride in 100 c.c. of distilled water; (3) a bottle of adrenalin chloride (1 in 1000). The two former solutions should be prepared and preserved in a flask stoppered with sterile cotton wool. Immediately prior to the performance of the operation, the anæsthetic solution is made up by mixing equal parts of 1 per cent. novocaine and salt solution, and to this four or five drops of the adrenalin chloride should be added. It will be found that for most purposes the  $\frac{1}{2}$  per cent. solution prepared is eminently satisfactory, but where a wide area has to be infiltrated a  $\frac{1}{4}$  or  $\frac{1}{8}$  per cent. solution may be used with perfect success. The amount which may be infiltrated with safety when the drug is prepared in the dilute forms described is really so great that there is no fear of inducing toxic phenomena. It is essential that, if anæsthesia is to be induced with the least amount of discomfort to the patient and annoyance to the surgeon, a satisfactory syringe should be used. There are many of these in the market, and with most of them, if care is taken to keep them in proper working order, no trouble will be found in their use. If care is taken of it, the "Record" syringe is very useful, or an "all metal" one may be employed. The syringe should be fitted so as to carry Schimmel's aseptic needles, and have a piece of bent tubing to allow of the point of the needle being introduced into the tissues obliquely. Hypodermic injection is found to give the most satisfactory results, and this is carried out in a manner that will render the subcutaneous tissue extremely œdematous. After the fluid has been introduced, the surgeon should allow at least ten minutes before commencing his operation, so that the anæsthesia may be absolute.

The disadvantages attending the use of local anæsthesia are few. The addition of adrenalin, although it confers a markedly increased degree of potency to the drug, and renders the anæsthesia much more complete,



has this disadvantage, that, when its action has passed away, and the contracted vessels dilate, slight hæmorrhage may occur. In most situations this is a matter of trifling moment, but occasionally, when operating in loose cellular tissue, such as the scrotum, troublesome bleeding may ensue. The use of the local anæsthetic has also this disadvantage, that it must of necessity to a certain extent lower the vitality of the tissue, and by this means possibly lead to the further dissemination of a septic focus.

*Venous Anæsthesia.*—This form of anæsthesia has only recently been introduced by Professor Bier, of Berlin. He was led to devise the method by observing how small an amount of the drug was required to induce very widespread anæsthesia, when it was introduced into the lumbar sac, in contrast to the large amount necessary to penetrate a nerve trunk, by hypodermic injection. It appeared to him that the natural channel in which the anæsthetic should be conveyed to the nerve was the blood-stream, and in order to do this, he has devised a technique whereby the area to be operated on is emptied of blood. A vein is exposed, and into it the anæsthetic fluid is introduced. The method is carried out as follows:—The region to be operated on is rendered bloodless by the application of an Esmarch's bandage from below upwards. A sterile, soft, thin rubber bandage is then wound round the upper and lower limit of this bloodless area, a vein is then selected, as, for example, the basilic, when the elbow joint is to be operated upon. This channel is opened into as near to the upper bandage as possible, and its proximal end ligatured. There is then transfused into the lower portion of the vein a solution of  $\frac{1}{2}$  per cent. novocaine, without the addition of adrenalin. The amount which can be introduced, according to Bier, is from 40 c.c. to 80 c.c., or (if a solution of one-half the strength is injected), from 100 c.c. to 150 c.c. A considerable amount of pressure may be required to overcome the venous valves. The effect upon the part is, that it becomes blanched and swollen, and is rendered soon completely anæsthetic. The portion of the limb beyond the bandage is also rendered "indirectly" anæsthetic. The former anæsthesia is almost immediate in onset. When the operation is completed, it is found advisable to wash out a certain amount of the anæsthetic from the vessels, by allowing slight bleeding to occur. This form of anæsthesia has not yet stood the test of time, but it will probably prove to be of very considerable use in cases where such operations as excision of joints are being practised.

*Spinal Anæsthesia.*—The rapid perfection which this form of anæsthesia has reached is one of the triumphs of modern surgery. A method which will allow of such scenes being witnessed as a patient lying quietly on the operating-table, and discussing topics of popular interest with the surgeon who is engaged in removing his rectum, or prostate, must command respect. When the same patient is seen an hour later lying in bed and reading a newspaper, obviously suffering little if any pain, profound admiration for the practice responsible for such a state of affairs cannot be withheld. A lucid conception of what the patient undergoes is given in a short article by "T. H. S.," in the *Journal of the Royal Army Medical Corps* for 1908.

"A slight prick in the small of the back, a sharp blow as the needle was driven home through the tissues, and a faint dragging pain as it felt its way into the spinal canal. That was all, and the entire process of anæsthetising, so dreaded by the patient, and so troublesome



to the operator, was over. In two minutes a warm glow spread slowly up both limbs, quickly followed by a tingling sensation in the feet. In another half-minute a heavy leaden feeling spread up both legs, and only the very slightest movement of the toes could be performed. The feeling of numbness gradually increased, with loss of sensation, and in three-and-a-half minutes there was a complete anæsthesia up to the umbilicus, and I was experiencing the curious condition that, with complete control of all my faculties, I was, for all practical purposes, dead from the waist downwards.

"During the whole operation, which was in the region of the right hip and the muscles of the thigh, not a single twinge of pain was felt until fifty minutes after the insertion of the needle, when cutaneous sensibility began to return, and the last few stitches were slightly painful. The spinal anæsthesia was produced whilst lying on the left side, and during the operation I found that there was not complete loss of sensation in the left leg, and that there was slight power of movement in the left foot. Slowly sensation began to return to the limbs, with the same tingling in the feet. I felt no nausea or unpleasant symptoms of any kind, and half an hour after leaving the theatre I was enjoying a cup of hot coffee and a cigarette, feeling very comfortable, and thoroughly convinced of the tremendous advantages of stovaine over chloroform.

"But four hours later I was not so sure about it, for I developed the most appalling headache, which lasted without a break for thirty-six hours, in spite of all treatment. Never have I experienced such a splitting headache, and I hope I never may again. To vary the monotony, I had attacks of agonising cramps in both legs, which lasted for an hour or so, and then gradually subsided, to be followed by another attack in a few hours. The cramps became less frequent, the headache wore away, and forty-eight hours after the injection I was my normal self once more.

"My experience of stovaine may be exceptional, and as far as I can gather, is so; but if the after-effects of spinal anæsthesia are likely to be as painful and prolonged as they were in my case, then it has no advantages over chloroform. Nothing would induce me to undergo the tortures of that reactionary period again, unless the administration of chloroform was out of the question. I have now tried both, and my experiences may be of some interest."

The introduction of spinal anæsthesia stands to the credit of Professor Bier, of Berlin. His was the pioneer work. He studied the effects of introducing a solution of cocaine and adrenalin into the lumbar sac. In fact he had the operation performed on his own person to enable him to observe the effects. The result of his researches was such as to lead him to discontinue the practice with such a drug as cocaine. Some five years later or so, Fourné introduced the practice of using stovaine. This drug has been found to possess very many advantages over cocaine, and with it many cases have been operated on in which perfect anæsthesia was obtained. As will have been seen, however, from the description of the personal experiences of one upon whom it was used, it has certain disadvantages, and many now prefer to use a newer drug—tropococaine. This latter drug is said to act more upon the sensory fibres than does stovaine, and it would appear to be responsible for fewer serious after-effects.

*Cases suitable for Spinal Anæsthesia.*—Spinal anæsthesia may be



practised on any rational-minded adult, where the operation is one involving structures below the iliac crests. The method has been used on children, but obviously this is attended with many disadvantages. It may be used in abdominal surgery, or even where the thorax is being operated on, if means are adopted to raise the level of the anæsthetic zone, but to be certain of doing so is difficult, and attended with increased danger. The class of case in which it is found to be especially useful is the one where some contra-indication to the use of a general anæsthetic exists, such as a patient with a senile heart. In no case should it be used where there is an infective focus, from which micro-organisms may escape into the general circulation, as the spinal anæsthetic might so lower the resistance of the cord and its membranes as to determine the circulating virus to that region, and thus set up a meningeal infection or myelitis.

*The Method of Inducing Spinal Anæsthesia.*—The preparation of the patient for spinal anæsthesia should be as careful and as thorough as for a general anæsthetic, because it is never absolutely certain that general anæsthesia may not ultimately be required. The skin of the lower part of the back is prepared as for an aseptic operation. In the adult man the spinal cord terminates beside the lower part of the first lumbar vertebra, and the subarachnoid space extends down to the second or third sacral vertebra. Into this space, containing the cauda equina, it is proposed to introduce the anæsthetic. The cauda equina is separated into two lateral portions by the cisterna terminalis, containing the conus medullaris and filum terminale, and it is especially into this cistern that endeavour will be made to plunge the needle. The safest and the easiest means of gaining access to this area is by median puncture in the second or third lumbar interspace. When the anæsthetic is introduced into the area above mentioned, it mixes freely with the cerebro-spinal fluid, and complete bi-lateral anæsthesia is induced.

Immediately prior to the patient being sent to the operating-theatre it will be found a useful procedure, especially in the case of the surgeon new to this form of anæsthesia, to introduce under the skin to be punctured a few drops of a local anæsthetic, such as  $\frac{1}{2}$  per cent. novocaine with adrenalin. This will get rid of the slight pain arising from the introduction of the spinal needle, and enable the surgeon to withdraw the needle and introduce it at another level, should he fail in his first attempt. When the patient is admitted to the theatre, there is found ready for use a Bier's Spinal Anæsthetic syringe. This consists of a trocar and cannula, the former with its point ground accurately to fit the oblique mouth of the cannula. A pair of these are provided in the case along with a 2 c.cm. "Record" syringe. All have been tested and have been found to be working smoothly, with the needle point sharp, and have been sterilised by boiling in distilled water. The presence of any such substance as soda in the water is liable to render the anæsthetic fluid inert. The most convenient form in which the tropococaine can be obtained is in ampoules, containing .06 grams of the drug, made up in a 5 per cent. sterilised solution, with .6 per cent. common salt. Prior to use, the outer surface of the ampoule is sterilised by immersing it in a solution of spirit and biniodide of mercury (1 in 500), or any other suitable antiseptic. This is washed off with sterilised water. The neck of the small flask is broken, and the contents of it aspirated into the syringe, through one of the cannulæ, which has



been fitted to it. All air is then carefully expelled from the syringe, and it is laid aside on a sterile towel or, what is better, held by an assistant in a sterile swab.

The patient having been placed on the operating-table, he is made to sit up with his knees drawn up and his head bent to its extreme limit on his chest, so as to produce the greatest degree of posterior spinal convexity. The advantage of this attitude over that where he sits with his legs over the side of the table is that he is unable to straighten his back and so displace the point of it if a hand is placed lightly on the nape of his neck when the needle is introduced. The skin of the back is again carefully cleansed by an assistant, the surgeon occupying the time in cleansing his own hands and putting on sterilised rubber gloves and the usual sterilised clothing. All being ready for the introduction of the needle, the surgeon locates the third lumbar interspace by first finding the fourth lumbar spine, which is situated at the level of a line connecting the highest points of the iliac crests. With the thumb of one hand he presses firmly against the third lumbar spine, and, taking the unused trocar and cannula from the basin of sterilised water in which it lies, he thrusts it steadily through the skin over the third interspace. He takes care to rigidly adhere to the mid line, and to carry the needle with its point at right angles to the vertebral column. In many cases no difficulty will be experienced in puncturing the lumbar sac, but in some the needle will be found to immediately impinge on bone. If such is the case, the needle should be withdrawn slightly, and its direction altered in a vertical plane. Sometimes it will be found that the laminae are struck when the point of the needle is deeper in the tissues. Should this occur, the point should again be withdrawn slightly, and a new channel sought for. When failure follows a second attempt, it is advisable to withdraw the needle entirely and commence from the beginning again at a different level. There is no difficulty in recognising when the needle has pierced the membranes covering the lumbar sac. An absence of resistance is felt, and perhaps the patient feels a twinge of discomfort. When this is accomplished, the *stilette* is withdrawn, and cerebro-spinal fluid flows out freely. This free escape of cerebro-spinal fluid is the only certain indication that the lumbar sac has been pierced. It is further essential that it should be seen to flow freely before proceeding with the next stage of the operation. It is not sufficient to observe a mere wetting of the needle, or to obtain fluid with difficulty on aspirating with a syringe. It is advisable to allow only a small quantity of the cerebro-spinal fluid to escape. Therefore, when the stream is seen to flow freely, the syringe is taken from the hand of the assistant, the cannula which still protects its point is removed, and the nozzle of the syringe is introduced into the second cannula, which projects from the skin of the back. The piston of the syringe is then steadily withdrawn, to allow a certain amount of the cerebro-spinal fluid to mix with the tropococaine solution in the syringe. The piston is then pressed slowly home, until all the anæsthetic fluid is driven into the lumbar sac. When this is accomplished the needle is withdrawn and the puncture wound of the skin dressed with sterilised celloidin or collodion. The patient is now allowed to lie recumbent in the dorsal position, his head raised on the pillow. Should an especially high degree of anæsthesia be desired, the table should be tilted into the Trendelenburg position for two minutes. In a



few minutes the patient complains of numbness and tingling in his lower limbs. This gradually progresses, until complete anæsthesia to pain supervenes, in from seven to ten minutes. Three-quarters of an hour's anæsthesia is easily obtained by this means. After-effects are usually slight. Occasionally cramps are felt in the limbs, or sickness and vomiting may occur. Rise of temperature on the night following the operation is not at all unusual. Where high anæsthesia has been obtained by tilting the table, there have been cases where temporary paralysis of the diaphragm occurred, and artificial respiration was required. This is, however, an avoidable complication.

The mortality from spinal anæsthesia is already as low as that from chloroform; it will undoubtedly get still lower. When the possibilities it opens up to the medical man who is so placed that to obtain assistance is difficult, it must be realised how great a boon to modern surgical practice this will ultimately prove to be.

**Aneurism.**—SURGICAL TREATMENT.—It is to the credit of Rudolph Matas, of New Orleans, that he has added to the great variety of methods of treating aneurism by surgical operation, a new procedure based on an entirely new principle. Although the methods previously in use are very various, the underlying principle in all of them may be said to be to cause obliteration of the sac by arresting the blood-flow through it. This is done in many different ways, such as when the proximal or distal ligature is used, or where such means as electrolysis is adopted to cause the formation of a clot inside the cyst, a clot which, by allowing rest to the part, and by forming a scaffolding, will allow organisation and obliteration of the sac to take place.

The surgical cure of aneurism has been for long carried out by two methods. The old operation of Antyllus, in which the sac was left *in situ*, its contents evacuated, and the artery with which it was connected ligatured on the proximal and distal side of the cyst. In the more recent operation the sac is excised completely, by dissecting it out from the tissues in which it is embedded. This method has been especially employed since the advent of the aseptic era in surgery. A disadvantage common to all the older methods is the obliteration of the flow through the arterial vessel with which the aneurism is connected, and the liability of so devitalising the tissues as to lead to necrosis and gangrene. Matas's operation, on the other hand—endo-aneurismorrhaphy, as he calls it—is one which permits of the sac being obliterated and the lumen of the vessel with which it is connected being preserved in certain suitable cases. Even in the less favourable cases, it will be found to have the advantage over the method of complete excision that it is associated with less loss of blood and less damage to the nutrition of the surrounding tissue. In Matas's operation the sac is not extirpated or disturbed, except in so far as is necessary to freely expose its interior and evacuate its contents. No ligature is applied to the artery. The circulation in the sac is arrested by closing with sutures the mouth of the sac, where it opens into the artery. The sac is then obliterated by coaptation of its walls with each other or the skin covering it.

The operation is applicable to all aneurisms in which there is a distinct sac, and in which the proximal end of the artery can be provisionally controlled. It is especially applicable to all forms of aneurisms of the larger arterial trunks. It may be practised both



in the spontaneous, true aneurism and in the traumatic aneurism which communicates with a well-developed and circumscribed sac. The fusiform and sacculated aneurisms are especially suitable cases for Matas's operation.

The underlying principle in the mind of the author of this new method of surgical treatment of aneurism is that the aneurismal sac is to be regarded as a large diverticulum of the parent artery. The lining of the membrane of the sac is a continuation of the endothelial covering, and, when the sac is not disturbed from its vascular connection, it is capable of exhibiting all the reparative and regenerative reactions which are manifested by other endothelial surfaces, such as the peritoneum.

TECHNIQUE. — Prophylactic hæmostasis is practised, either by temporary compression of the main artery, or by the application of an Esmarch's tourniquet. When all pulsation in the tumour has been arrested, an incision parallel to the long axis of the aneurism is made down to the sac. This is exposed from end to end. Any important structure, such as a large nerve, is freed from the sac, should it be found adherent to it. The sac is then opened, and its contents evacuated. In the fusiform aneurism two large openings will be seen, connected by a narrow groove, which represents the continuation of the floor of the parent artery. In the sacciform type a single opening connects the sac with the main artery. The interior of the sac is now gently but thoroughly scrubbed with a gauze swab, soaked in saline solution. This removes any laminated clot adherent to its wall. All the visible orifices where collateral blood-vessels open into the sac are now rapidly closed by sutures. The communication between the sac and the artery is now closed. This is done by means of continuous or interrupted sutures. Well-prepared chromatised catgut is to be preferred for this purpose. Where a fusiform aneurism is being treated, this procedure will result in the obliteration of the lumen of the vessel, but where a sacciform aneurism is present, the lumen remains pervious. A second row of interrupted sutures is inserted similar to the layer of sero-muscular Lembert sutures used in intestinal anastomosis. Before proceeding with the next stage of the operation, the tourniquet or compress controlling the blood-flow is removed, and the sutures by this means tested. Obliteration of the sac is now proceeded with. This is done, when possible, by further inverting the edges of the sac. One or two relaxation sutures are introduced on each side of the mid line tacking the skin flaps to the bottom of the sac. The margins of the skin wound are then united, and where previously a bulging pulsating tumour existed, a hollow is seen. No drainage tube is inserted. The limb is encased in cotton wool, and fixed upon a splint.

The opinion of those surgeons who have performed Matas's operation is favourable to it. It is unlikely that it will ever be very widely adopted, but it will undoubtedly prove a most useful operation in a limited number of cases.



# Antenatal Pathology.

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DEFINITION.—The term *Antenatal Pathology* seems to have been first employed in its present sense by Ballantyne in his work (of which only two volumes appeared) entitled *Diseases and Deformities of the Fœtus: an Attempt towards a System of Antenatal Pathology* (1892, 1895); and this writer adopted the name as the title of his large work, which was published some ten years later (*Manual of Antenatal Pathology and Hygiene*, vol. i. "The Fœtus," 1902; vol. ii. "The Embryo," 1904). As defined in the last-named work (*op. cit.*, i. p. 2) antenatal pathology is concerned with all the morbid processes which act upon the organism before birth, and with the effects which they produce by their action; it deals with the pathology of the individual during his foetal and embryonic existence, and for this reason it might be named intra-uterine pathology; but it includes also the consideration of the morbid agencies which influence the germ (ovum or sperm) in the period which precedes the beginning of embryonic life, and it therefore embraces also the study of morbid heredity or of pre-embryonic or germinal pathology.

SUBDIVISIONS AND CLASSIFICATION.—With the scope given to it by this definition, antenatal pathology requires to be subdivided in order to be conveniently studied. Beginning at the point nearest to birth and working backwards towards conception and the events which precede it, Ballantyne names three large subdivisions of the subject, viz. foetal pathology, embryonic pathology, and germinal pathology, corresponding to the foetal, embryonic, and germinal periods of antenatal life. The foetal period occupies by far the largest part of the mother's pregnancy; it may be said to extend from the eighth to the fortieth week, or thirty-two weeks in all (seven calendar months roughly); the embryonic period lasts from the end of the first week to the eighth week of antenatal life, although Ballantyne gives to the last fortnight (seventh and eighth weeks) the special name of the neofoetal period (a transition time); and the germinal epoch is that time in life which precedes the first appearance of the embryonic rudiments, which corresponds, therefore, to the first week of antenatal life (that immediately following conception), and to the long time before that event when the germ-cells (ovum and sperm) were lying in the parent organisms and were being prepared for their great culminating function of forming a new being. Sharply defined in its terminal period by birth, antenatal life stretches away back almost indefinitely in the other direction into the shadowy vitalities of the reproductive cells of the parents and their ancestors, till, theoretically at least, it reaches the ovum and spermatozoon of the primitive pair. Each of these periods of antenatal life has its own characteristic pathological developments, in a certain sense each of them has its own form of death; and in each of them the special physiology of the time has its effect upon its pathology and death. Speaking generally, the foetal period is characterised by the occurrence of diseases, the embryonic by monstrosities and malformations, and the germinal by the coming into action of pathological tendencies and predispositions. The morbid developments of the foetal period are the diseases of the fœtus, those of the embryonic period are



the malformations of the embryo (corresponding to a large part of teratology), and those of the germinal period are morbid heredity showing itself in various ways. Such is a generalisation of the multiform morbid states grouped together in antenatal pathology; if an attempt be made to particularise, it is found that there are no clear-cut lines of demarcation, and that the pathological developments of one time cannot be separated with mathematical precision from those of another, but overlap to a great or small extent. Keeping this modifying circumstance in mind we may try to form some idea of the scope and contents of each of the three periods.

FŒTAL PATHOLOGY.—During the foetal period of life the organism (the foetus) shows its vitality chiefly by growth along lines which have been already definitely laid down. In this respect it resembles the subsequent postnatal period of infancy rather than the precedent antenatal one of embryonic existence. It is growth rather than development that is its distinguishing mark. It is true that the intra-uterine environment has very distinctive and peculiar characters—the unborn infant exists in a fluid medium of practically constant temperature, it is protected from traumatism by the maternal structures, and it is shut in from the light; further, the foetus has several of its organs almost inactive, and its most important and most active organ, the placenta, is extra-corporeal. Nevertheless, the chief phenomenon of foetal life is growth, rapid and continuous, along lines already indicated; within seven months the organism increases from a structure 1 inch in length to one measuring 20 inches, and its increase in weight is from 1 ounce to 7 or 8 pounds. In these facts is found the explanation of much that is puzzling in foetal pathology; the more clearly we recognise the physiological characters of foetal existence, the more easily shall we solve the riddle of the peculiarities of the diseases which affect the unborn infant. At the basis of the understanding of foetal morbid states is the knowledge of the anatomy and physiology of the foetus. In his work referred to above (*Manual of Antenatal Pathology*, i. pp. 172, 429), Ballantyne applies these principles to the study of the transmitted and idiopathic diseases of the foetus and of foetal death. Thus, in connection with infection of the unborn infant with *typhoid fever*, he points out that the characteristic intestinal lesions are seldom met with, and he explains this by the fact that the intestinal functions are almost quiescent during antenatal life, and by the avenue of entrance of the infecting agent in the case of the foetus. The latter fact is one of considerable interest and importance. Since the maternal blood comes into close relationship with the foetal only in the placenta, it follows that germs can pass from the former to the latter only through that organ; foetal infection, therefore, is by way of the placenta, the umbilical vein, and the umbilicus, and the unborn infant has diseases transmitted to it, not through the buccal, pharyngeal, pulmonary, or intestinal mucous membranes, but through the blood which reaches it at the umbilicus. The lesions which this infection will cause will therefore have a localisation different from that which is found in the adult; they will have the umbilicus as a centre, and will be most likely to be discovered in the organs nearly related by vascular connections to the umbilicus. Consequently, in foetal typhoid the typical bacillus is found commonly in the placenta, the blood, the brain, the spleen, and other organs, but intestinal lesions are very uncommon. In such cases the foetal blood has shown Widal's



test, proving that agglutinins also are transmitted from the mother to the foetus, or are developed independently in the latter. Foetal *tuberculosis* is another malady which is affected by the antenatal environment, and the foetal method of acquiring a microbic morbid state: the lungs of the unborn infant suffering from tubercle usually show only scattered bacilli, whilst the liver (which is the first organ to receive the infected blood of the umbilical vein) contains, as a rule, great numbers of them and exhibits tubercular lesions; the spleen likewise is affected, and bacilli are to be found in the placenta and in the blood of the umbilical vein; and, on the other hand, tubercular lesions of the intestine are very rare. The same general system of distribution may be traced in other transmitted diseases of the foetus, such as small-pox, syphilis, and malaria; and in transmitted toxicological states, such as lead-poisoning, the same rule applies, the metal being discovered in the liver, spleen, and brain, as well as in the placenta. The idiopathic diseases of the foetus, such as general dropsy, ichthyosis, elephantiasis, etc., do not indeed show any peculiarity in the matter of the localisation of the characteristic lesions of these maladies, but they do exhibit the effects of the intra-uterine environment and the preponderating influence of the placenta in antenatal life. Foetal ichthyosis, for instance, reaches a stage and a degree never seen in postnatal life; and the explanation is to be found doubtless in the fluid medium in which the foetus lies, which, on the one hand, prevents the action of friction, and on the other, encourages an extraordinary proliferation of the epidermic layers of the skin. General foetal dropsy, also, attains a degree never seen in oedema of the adult; and the reason is to be found in the placenta, which can keep even a seriously diseased foetus in life, the latter being a semi-parasite upon its mother through the placenta. The proof of this statement is found in the fact that such a foetus is incapable of an independent existence when removed from the intra-uterine economy, as occurs at the moment of birth; by the help of the placenta the foetus can live on in utero with every one of its organs waterlogged and physiologically useless, but at birth conditions are altered, and the newborn infant is either stillborn or rapidly dies. There are some morbid states of the foetus, however, which have peculiarities not to be satisfactorily explained either by the environment, the mode of microbic invasion, or the predominance of the placenta; such are the bone diseases (achondroplasia, foetal rickets, etc.), some of the skin diseases (hypertrichosis congenita, tylosis palmæ, etc.), and certain maladies of the bladder, heart, kidneys, and bile-ducts. In these curious pathological conditions we have to look elsewhere for an explanation of their characters; and Ballantyne finds it in the fact that all parts of the new organism do not pass into the foetal period at the same time, some remain in the embryonic stage whilst the others, having developed fully, go on into the foetal. Some of these so-called maladies are really malformations, at least they occupy a place midway between the diseases and the teratological states; their peculiarities, therefore, are the result of morbid agents acting upon tissues still in the formative or evolutionary state.

EMBRYONIC PATHOLOGY.—During embryonic life (which lasts, roughly speaking, from the end of the first week to the end of the sixth, from the appearance of the first embryonic rudiments in the embryonic area of the blastodermic vesicle to the completion of the development of the new organism and its revelation as a recognisable human embryo)



it is development, not growth, which is the characteristic feature. There is growth undoubtedly, but so marked, so arresting are the phenomena of development which are going on that they mask all else, and it is impossible to avoid coming to the conclusion that the physiology of the embryo is typically embryology. Embryology is, so to speak, almost the only function of embryonic life; to gain a clear idea of this stage in antenatal existence it is necessary to think, not of organs performing functions, but of organs being formed; embryonic physiology has to do, not with organs and their special activities, but with the special activity which produces, builds up, and perfects the organs themselves. The great, almost the only, function of the embryo is to form tissues and organs, or, in one word, organogenesis. We have to imagine an aggregate of cells arranging themselves, apparently in a disorderly fashion or in a fashion of which the order is but dimly discerned, first, into the three layers of the blastoderm, and then, after many intermediate stages and phases, into the organs which take on the particular functions of foetal and postnatal life. There is no anatomy of the embryo apart from its physiology; the two are united together in the subject of embryology, which, as it were, contains them. It is only in foetal life that the distinction between matters anatomical and matters physiological begins to become apparent; after birth it is, of course, quite evident. For the sake of strict accuracy, however, it must be added that the later part of embryonic life is not without indications of functional activity, in the ordinary sense of the term, and some of the organs, *e.g.* the heart, are performing other acts than those of formation or construction merely. There is no sharply marked boundary between embryonic and foetal life in this respect, but rather a gradual passage; still, the fact remains that the principal manifestation of embryonic life stands out prominently as organogenesis.

The existence of so fundamental a dissimilarity between the physiology of the embryo and that of the foetus prepares us for the statement that the pathology of the embryo is startlingly unlike that of the foetus; it is a pathology *sui generis*. To state the matter concisely, the pathology of the embryo is teratology. Since the chief result of the physiological activity of the embryo is the formation of parts and organs, so the chief result of pathological processes in the embryo is the malformation of its parts and organs; the one leads to normal formation, the other to abnormal formation. Monstrosities and structural anomalies are the results of morbid agents acting upon the organism in the embryonic period of its existence, or, to write more exactly, upon such parts of the organism as are in the embryonic or formative stage. Experimental teratogenesis would seem to show that the morbid agents are in no way peculiar to the embryonic period, but are, in fact, the causes (microbic, toxic, toxicological, traumatic) which produce diseases by their action upon the foetus and adult. In the case of the embryo they are called teratogenic, and in that of the foetus or adult they are named pathogenic; but there is no sufficient reason for supposing that in their essential nature they differ one whit. It is the result which is dissimilar, strangely and strikingly dissimilar, being in the one instance teratological and in the other pathological. The mode of action of the cause is no doubt different, and the organism upon which it acts and its surroundings are indeed widely different; and it is in this manner that the vast difference between the results—a monstrosity and a disease—is produced. The pathology of the



embryo, then, has to do with monstrosities and malformations, with, in other words, the teratological states. At the same time Ballantyne suggests (*Manual of Antenatal Pathology*, ii. p. 6) that all that is teratological does not of necessity belong to the embryonic period; some organs are still in the embryonic phase when, as far as time goes, they are in the foetal period, and they may develop malformations at this later epoch. Again, there is reason to believe that some teratological states are determined in the germinal period; united twins, for instance, may originate then. Ballantyne's main thesis, however, is that embryology is the key to the understanding of teratology; the latter is a disturbance of the former, teratological results being produced by irregularities in embryological processes. Normally the embryology of the facial region, although, indeed, most complex, results in the formation of the facial features without let or flaw; but if the organogenetic processes be interfered with, if one fissure closes too soon or too late, or if one process projects too far or not enough, facial deformities, such as hare lip or genal fissure, are produced. Embryology in disorder, then, is teratology. Further, when we come to ask how the embryological disorder is brought about, we find an answer to our question in the immediate environment of the embryo. Normally the embryo floats free in the liquor amnii; but if, from scarceness of the liquor or from adhesiveness of the embryo or of the walls of the embryonic sac, the amnion comes in contact with and becomes united to the embryo, then that part of the embryo so affected is arrested or distorted in its development, and a malformation results. At a later stage the embryo, now grown into a foetus, may separate from the amniotic wall, and so the demonstration of the causation of its deformed condition may no longer be made patent. Amniotic pressure, for instance, can be made to account for such an apparently inexplicable teratological state as symphodia: the lower limbs at the early stage of development, when they are bud-like rudiments, get pressed together, and at the same time rotated in such a fashion as to produce the characteristic sireniform monstrosity. Some monstrosities, it is true, more especially those in which two embryos are concerned (placental parasites, united twins, etc.), cannot be entirely explained by a reference to embryological states and the arresting amniotic factor; for their elucidation it is necessary to consider conditions prior to embryonic life, germinal anomalies in fact; but the great majority of the deformities which affect the unborn infant have an embryological and amniotic explanation. There is also reason to believe that the teratogenic pressure is not always amniotic in nature: it may sometimes be caused by pelvic or abdominal tumours, by deformities of the uterus or narrowness of a tubal gestation sac, by the umbilical cord, or even by one part of the embryo compressing another. Experimental teratogeny, however, seems to demonstrate that amniotic narrowness is the most frequent factor in the production of monstrosities.

GERMINAL PATHOLOGY. — "The pathology of the germ," writes Ballantyne (*op. cit.*, ii. p. 607), "is the Hinterland of Antenatal Pathology," and it is true that of its characters we know extraordinarily little; it is almost wholly an unexplored territory. To begin with, we have very little information of the life of the human germ before the appearance of the first rudiments of the embryo in the embryonic area of the blastocyst. This is the *terminus ad quem* of germinal life, and corresponds, roughly speaking, to the end of the first week after the



occurrence of impregnation. The *terminus a quo* is much more difficult of definition: for the individual life it may be regarded as the conjunction of ovum and spermatozoon in fertilisation, but it really begins much further back, when the reproductive cells of the parents become specialised from the cells of the genital ridge. Germinal life then consists of a short period (a week) of single existence, and of a long precedent period of dual existence, when the germ cell and the sperm cell are lying apparently dormant in the tissues of the parent organism. Further, inasmuch as the germ cell is believed to contain a particle of the structural elements of the germ of the preceding generation, and that a particle of the generation before, and so on, it becomes impossible to fix a starting-point. In this sense germinal life is without beginning, an idea which plays a large part in the modern theories of heredity; but, for practical purposes, we may regard the germinal life of the individual as beginning in the vital activities of the two reproductive cells of his parents, in the ovum and the spermatozoon which by their union cause him to come into being. After a long period of what may be termed latency in the Graafian follicle of the ovary, the ovum undergoes the process of maturation, is expelled from its ovarian habitation, is transmitted through the Fallopian tube, and reaches the uterus. Either in the tube or in the uterus the ovum is fertilised by a spermatozoon, an event which marks the commencement of a unified germinal life; intricate changes are thus occasioned which lead to the formation of the morula mass and to the appearance, first of the extra-embryonic structures of the blastocyst (umbilical vesicle, chorion, amnion, etc.) and later of the embryonic rudiments in the specialised part of the blastocyst known as the embryonic area. The spermatozoon which plays so large a part in initiating this unified germinal life has also a past history, about which less even is known than about that of the ovum, during which it is subject to influences which no doubt deeply impress themselves upon the future development of the embryo.

Now, if the same principle of study be applied to the pathology of germinal life as was brought to bear upon embryonic pathology (*vide ante*), that, namely, of looking for an explanation of characteristic morbid developments along the line of physiological peculiarities, it will at once become apparent that, theoretically, the pathology of germinal life ought to consist of anomalies in the formation of the first rudiments of the embryo, of malformation of the blastocyst and its contained parts (amniotic sac, umbilical vesicle, trophoblast), of unusual modes of segmentation, of errors in the details of the impregnation of the ovum by the spermatozoa, of imperfect maturation of the ovum, of imperfect formation of spermatoblasts and spermatozoa, of irregularities in the site of fertilisation (ovarian or tubal instead of intra-uterine), and of the incidence of morbid influences upon the germ cells during the long time when these structures are lying in the genital glands of parents and ancestors. Germinal pathology may be expected to be made up of the pathology of the blastocyst, of that of the morula mass, of that of fertilisation, of that of maturation, and of all the effects of the subjection of the germ cells to abnormal influences in earlier periods of the life of the individual while in the dual stage of existence (*i.e.* morbid heredity). A theory constructed along these lines does, as a matter of fact, form a working hypothesis which serves to explain the diverse phenomena of germinal pathology;



anomalies of segmentation may be the causes of the hydatid mole and of the "rests" (themselves hypothetical) which many believe to have much to do with the etiology of tumours; irregularities in the place of fertilisation may have something to do with ectopic pregnancy; irregularities in the mode of impregnation (*e.g.* polyspermy) may be the root causes of double monsters; defects in maturation may underlie and explain the development of dermoid cysts and of the rare cases of foetus in foetu; and unusual chemical and physical agencies acting upon the germ cells in their long period of latency may be, in part at least, the determining factors in the production of "hereditary" anomalies. Ballantyne suggests further (*op. cit.*, ii. p. 617) that the same ultimate agencies are the causes alike of the pathological developments of germinal life, of the more strictly teratological states of embryonic life, and of the diseases of foetal existence; he believes these agencies to be toxic, microbic, toxicological, and traumatic; and he regards the diversity of results as due to the very different conditions under which the causes are acting, and to the very dissimilar character of the organism (germ, embryo, foetus) upon which they exert their morbid influence. He is of opinion, therefore, that there are no *special* causes of germinal deviations, of embryonic malformations, and of foetal diseases; the *special* characters of these morbid manifestations are to be explained in another fashion, they are to be looked upon as due to peculiarities of environment and to the characteristics of the life of the antenatal period of existence in question.

ETIOLOGY.—From what has been already stated regarding foetal, embryonic, and germinal pathology it will be evident that Ballantyne (*Antenatal Pathology*, vols. i. and ii., 1902, 1904) advocates the theory of the identity of morbid agency. He regards the morbid phenomena of antenatal life as due to the same causes as produce diseases in post-natal existence, viz. microbes, toxins, and toxic products, toxicological agents (chemical and vegetable poisons), and traumatism; and he explains the extraordinary difference in the results produced as brought about by the peculiarities of the life of the period dealt with and of the environment which is characteristic of this or that epoch of antenatal existence. The foetus, so to say, lives under the influence of the placenta, and this fact alone determines to a large extent the character of its morbid developments; the embryo is dominated by the amniotic environment, a circumstance which, taken along with the evolutionary and constructive nature of its vital activities, has much to do with the peculiar teratological nature of its pathology; and the germ has a life which is so extraordinarily different, both in its unified and in its dual existence, from anything else that it is not to be wondered at if its deviations from the physiological standard are also of their own kind, in a very special way. This theory is supported by the results of experimental teratogeny, or the artificial production of monstrosities, as carried out by Dareste, but more especially by the experiments of Féré, who injected toxic and toxic substances into developing hens' eggs with teratological effects. Franklin P. Mall (*Study of the Causes Underlying the Origin of Human Monsters*, 1908) has recently brought forward strong evidence in favour of the view that pathological embryos and small monsters are identical and are developed from normal ova due to external influences ("faulty implantation"); and these conclusions support to a large extent the view which has been advanced that teratology is simply disordered embryology, and that the cause of the



disorder is some influence acting upon the embryo from without. Schwalbe's fine work, now in process of publication, also contains many observations on teratogenesis which go to prove the teratogenic effect of external agents upon the organism in the embryonic stage of its existence (*Die Morphologie der Missbildungen des Menschen und der Thiere*, parts i., ii. and iii., 1906, 1907, 1909). There is still, however, a tendency among writers on these subjects to separate the monstrosities and malformations from the other results of the action of morbid agencies upon the organism before birth; teratology has for so long a time stood by itself that there is little likelihood of its being considered as nothing more than one subdivision of antenatal pathology. At the same time, evidence is accumulating which seems to show that morbid agents are the same at all periods of life, antenatal as well as postnatal, and that the differences in the pathological results produced at the different periods are due rather to the environment of the organism and to the special characters of its life than to any difference in the pathological causes.

**DIAGNOSIS.**—The diagnosis of antenatal states after birth calls for no special comment; its success or failure will depend upon the knowledge or the ignorance of the practitioner; and its performance requires no further skill than that which is necessary for the distinction and recognition of ordinary postnatal, medical, and surgical morbid conditions. But the difficulties of diagnosing pathological states while the subject of them is still in utero are many and serious, and the art of antenatal diagnosis has as yet made very little progress. Ballantyne gives a chapter of his book (*Manual of Antenatal Pathology*, i. pp. 430-450) to this subject; in it he claims that a careful scrutiny of the history of the parents before and about the time of conception, and, more particularly, of the mother during the months of pregnancy which have already elapsed, will often enable the medical man to form a strong suspicion that the unborn infant will be diseased or malformed. The physical examination of the abdomen in the later months of gestation will sometimes be successful in detecting gross enlargement of one or more parts of the foetus, and it may, in the hands of an expert, yield further information. The use of cephalometers and the employment of the Röntgen rays may in time serve as important adjuvants in the acquisition of knowledge regarding the state of health or disease of the unborn infant. It has to be borne in mind that hydramnios frequently means some anomaly or abnormality of the foetus; and, since the diagnosis of hydramnios can usually be easily made, its presence ought to make the obstetrician suspect a foetal morbid state. Foetal heart murmurs have been detected by auscultation during the later months of pregnancy, and there are signs and symptoms of foetal death which make it possible to diagnose this antenatal catastrophe before the child is expelled. If the attention of the medical man were more systematically turned to the subject of antenatal diagnosis, there would doubtless be a rapid increase in his knowledge of the matter and in his skill in applying it. Meantime the difficulty is to get the patient to allow, and the obstetrician to make, a routine examination during pregnancy; many pregnant patients are never examined even with a view to determining the relative size of the mother's pelvis and of the foetal head until the incidence of labour pains.

**TREATMENT.**—Antenatal treatment waits upon antenatal diagnosis, and in the absence of exact methods in the latter sphere of practice



the former is arrested nearly altogether. What little treatment is possible is largely empiric, *e.g.* the giving of chlorate of potash to the mother in cases of recurrent abortion or repeated foetal death; but some definiteness has been introduced into the subject by the topical administration of mercury when the mother is syphilitic. There has indeed been an advance in the treatment of antenatal morbid states within the past ten or twelve years, but it has been in the sphere of reparative surgery applied after the birth of the infant; partially successful attempts have, for instance, been made to separate united twins, and some of the grave malformations of the cranium and its contents have been attacked with at least a cosmetic advantage. Extroversion of the bladder, absence of bones of the leg or arm, and exomphalos have been dealt with in new ways which augur greater success than in the past. We are still, however, standing on the threshold of preventive medicine as applied to antenatal morbid states.

**Aphasia.** (See also APRAXIA).—In a series of essays which appeared in the *Semaine médicale* during 1906, Pierre Marie, one of the most eminent of living neurologists, has severely criticised the current doctrine of aphasia. The views he expressed have neither received general acceptance, nor have they been effectively controverted, and, pending further research, all that is necessary is to summarise Marie's leading contentions.

His criticisms are based on clinical observations, and on more than fifty autopsies on aphasic patients. He is peculiarly fortunate in having so much material at his disposal, and it is not unnatural that he should urge that the best way to study aphasia is from a clinico-pathological standpoint pure and simple, in preference to being influenced by theory and graphic representations of the speech mechanism. The leading features of Marie's conception of aphasia are that there is always (1) more or less difficulty in comprehending spoken language, and (2) a marked diminution in the general mental capacity.

The failure to understand speech which all aphasics manifest has escaped recognition because of the simple nature of the ordinary test questions. A patient may be able to show his tongue at request, but cannot execute a more complicated order. A clinical test employed by Marie is as follows:—"There are three pieces of paper; give me the biggest, crumple up the second one and throw it on the floor, put the smallest in your pocket." No aphasic, he says, can do this correctly. A further reason why mental impairment has evaded notice is that the affective faculties are less affected than the intellect. Thus, a patient continues to act normally in his family and social relations, but he loses the accomplishments which he has gradually acquired—the musician can no longer compose, the cook produces uneatable dishes, the business man forgets simple arithmetic, and so on.

Marie subdivides aphasia into one subordinate and two main symptom groups:—1. *Anarthria*, in which speech alone is lost, but the patient can read, hear, and understand. 2. *Wernicke's aphasia*, in which the patient can speak, though badly, understands badly, and cannot read or write. The inability to read and write is not word deafness or blindness, but arises from mental impairment. 3. *Broca's aphasia*, in which the patients can neither read nor write, understand badly, and have lost the power of speech. Obviously, the only difference between



(2) and (3) is the retention or loss of the power of speech, and Marie regards this as the essential distinction between them.

From a pathological point of view, his classification is even simpler. Broca's aphasia is simply (1) plus (2)—Wernicke's aphasia with anarthria. Anarthria is caused by lesions of the lenticular region on either side; there is failure of co-ordination of the movements required for speech, but no paralysis. The lesion causing Wernicke's aphasia is in the "association centre" of Flechsig—the left supra-marginal and angular gyrus and first and second temporal convolutions. Lesions in this region are generally due to obstruction of the sylvian artery. The larger the area of softening produced, the more severe is the aphasia, and the more likely is the lenticular region to be jointly affected. Individual variations in the distribution of the vessels play an important part in producing variations in the clinical picture. Mental deterioration is on the whole less in motor than in sensory aphasia, because the lesion causing the former is generally farther removed from the cortex.

Marie admits that pure, or almost pure, word blindness also exists. He looks on it as due to softening in the domain of the posterior cerebral artery, and localises the lesion in the left lingual and fusiform lobes on the inferior aspect of the cerebrum, impairing the integrity of the optic radiation.

Marie's destructive criticism must now be referred to. His chief contentions are:—(1) Broca's (the third left frontal) convolution has nothing to do with aphasia, because (*a*) in some right-handed persons its destruction has not caused aphasia; (*b*) it has been found intact in some well-marked cases of Broca's aphasia; and (*c*) its frequent involvement in cases of aphasia is merely a coincidence, and arises from the fact that the blocking of the sylvian artery which causes softening often occurs proximally to the vessel supplying the third left frontal, and hence affects that along with Wernicke's area. (2) Pure word deafness does not exist. Alleged instances arise from mal-observation and failure to recognise minor degrees of labyrinthine deafness. The first left temporal convolution is not a centre for the memory of words. (3) Pure motor aphasia is nothing but anarthria. (4) No distinction exists between cortical and subcortical aphasia, for no aphasia due to a focal lesion is ever purely cortical.

Marie's positive teaching may be summed up thus:—Aphasia is either intrinsic (Wernicke and Broca—language area involved), or extrinsic (anarthria—language area not involved). Wernicke's area contains the true speech centre; it is an intellectual rather than a sensory centre. There is always intellectual defect in aphasia. The degree of speech disturbance depends on the size of the lesion. Pure word blindness differs from the other forms in being due to lesions in the domain of the posterior cerebral, not the sylvian artery.

LITERATURE.—MARIE. *Sem. méd.* (Paris), Nos. 21, 42, 48, 1906; *Presse méd.* (Paris), No. 4, 1907.—DEJERINE. *Presse méd.* (Paris), pp. 437, 453, 742.—BLASSBERG. *Wien. klin. Wochens.*, Aug. 13, 1908.—MAYENDORF. *Berl. klin. Wochens.*, Aug. 10, 1908. A valuable *résumé* of the subject is contained in an article by COLLIER, *Brain*, xxxi. p. 523, 1908.

**Apraxia.**—In connection with Marie's theory of aphasia, according to which the third left frontal convolution is deposed from its position as a centre for the memory of words, it is of interest to remember that recent work on apraxia (a subject brought into notice



by Liepmann) tends to show that certain functions, comparable to that of speech, are localised in the first and second frontal convolutions, and therefore in so far supports the older hypothesis as opposed to Marie's views. By apraxia is meant a condition of inability to execute skilled movements with the limbs, apart from paralysis, disturbance of sensation, defect in co-ordination, or intellectual impairment. The ability to perform purposive movements of the limbs, either right or left, is supposed to depend on the integrity of the posterior part of the first and second left frontal convolutions, which are probably connected with the left side of the body by the anterior fibres of the corpus callosum. It is obvious that "motor aphasia bears the same relation to the movements of the muscles concerned in speech as does apraxia to the movements of the limbs. Motor aphasia, pure or cortical, is clearly synonymous with apraxia, pure or cortical, of the movements concerned in speech, and motor agraphia is apraxia pure and simple. According to this view a series of higher motor centres concerned with certain subjectively purposive movements are situated in the posterior parts of the three frontal gyri and immediately in front of the Rolandic centres (lower motor centres) for the corresponding regions of the body. Lesion of these centres is productive of phenomena of a similar order in the corresponding region of the body—namely, motor aphasia, motor agraphia, and apraxia. At a time, then, when the most determined efforts are being made, and upon grounds which are at least logical, to dismiss the left third frontal gyrus from our conception of the essential speech mechanism, evidence of a very strong nature is increasingly coming to hand which calls for the retention of Broca's area as a speech centre, entirely apart from the consideration of local lesions of the brain causing speech-defect." (Collier, *Brain*, xxxi. p. 529, 1908.)

[For a general review of apraxia, see Wilson, *Brain*, xxxi. p. 164, 1908.]

**Arterial Hypertonus.**—This term was introduced by Russell to denote a condition of the arterial wall characterised by tightening up of its muscular fibres (*Encyclopædia Medica*, Vol. XIII. p. 356). His recent work on the subject is extremely suggestive, and has attracted a great deal of attention. The pathological changes in the arterial wall which are of importance clinically are atheroma, obliterative endarteritis, calcareous infiltration of the tunica media, and arterio-sclerosis. The features of these are described in the *Encyclopædia* article referred to above. Russell has been one of the first to show that a clear distinction must be drawn between atheroma (a focal lesion, chiefly of the intima, progressing to degenerative changes) on the one hand, and arterio-sclerosis on the other. Moreover, he has shown that in the production of what is clinically known as arterio-sclerosis two factors are operative; one a permanent one—a thickening chiefly of the media, the other temporary, or often so—a hypertonic contraction of the vessel wall. A further point is that hypertonus in this sense may affect normal, or atheromatous, as well as sclerosed vessels.

Russell was led to his conception of the morbid anatomy of arterio-sclerosis by examining radial arteries which had shown marked thickening during life. He found that the thickening was due to hypertrophy of the muscular fibres of the tunica media, hyperplasia without degeneration of the subendothelial tissue of the tunica intima, and sometimes fibrous hyperplasia of the tunica adventitia. These changes obviously



differ essentially from atheroma; moreover, they are not confined to a limited area of the vessel wall, but are widely distributed throughout the body. They may be associated with atheroma of the aorta, but this is only coincidental. The renal vessels are peculiar. In the artery outside the kidney the above changes are found; in the intra-renal arteries there is atrophy of the muscular coat, and very marked hypertrophy of intima and adventitia, culminating in occlusion of the vessels and their transformation into fibrous cords. The term *arterio-sclerosis*, then, is applied to all cases of vascular thickening other than atheroma, including (*a*) pure hypermyotrophy, (*b*) hypermyotrophy with thickening of the internal coat, and (*c*) with the adventitia also thickened.

The two important points which Russell has elucidated are—(1) that there exists a permanent diffuse thickening of the arteries which is not atheroma; and (2) that sclerosed vessels retain their contractility (hypertonus). The reasons for the first proposition have been stated; evidence of the correctness of the second is afforded by clinical observations that under appropriate treatment tightened up arteries can be made to relax. While sclerosis is irremediable, hypertonus is not; the vascular thickening of arterio-sclerosis is therefore not wholly beyond the reach of treatment.

Hypertonus may be produced by vaso-motor influence; a much more important factor, however, is the composition and condition of the blood. Nitrogenous waste, and the products of imperfect metabolism circulating in the blood, cause a contraction of the arteries and capillaries, and this is the first step in the chain of events which lead to increased blood-pressure and arterio-sclerosis. The action of the deleterious substances (the exact nature of which is unknown) is conceived of as a direct one on the vessels, not an indirect effect brought about through the agency of the nervous system. It has a twofold protective action on the tissues: (*a*) in diminishing the supply to them of the impure blood, and (*b*) in producing symptoms which lead to blood purification.

EFFECT OF ARTERIAL HYPERTONUS ON MANOMETRIC READINGS AND ON BLOOD-PRESSURE.—Russell is very definitely of opinion that the high readings in arterio-sclerosis do not represent the actual blood-pressure, but are caused by the resistance which the thickened vessel wall offers to the compression of the armlet. Experimenting with a system of rubber tubes of various diameters and thickness of wall connected with a series of manometers, he got results of which the following is an example:—The internal pressure of the system being 30 mm. Hg by the manometers, the pressure (as measured by Oliver's hæmodynamometer) required to obliterate the lumen of the tubes was 10 mm. Hg in the case of the thinnest (A), 40 mm. Hg in the medium one (B), and 84 mm. Hg in the thickest one (C). The walls of tube A were so flaccid that they were only kept apart by the internal pressure, and this internal pressure was overcome by a lateral pressure of 10 mm. Hg, hence in B the resistance of the walls must have been 30 mm. Hg (40—10), and in C, 74 mm. Hg (84—10).

Deleterious matters ("muscular excitants") being present in the blood, they cause a tightening up of the arterioles and arteries, at least vessels up to the size of the brachial. The aortic blood-pressure is raised in consequence. It is not, however, raised *in the constricted arteries themselves*. Less blood flows through them, and less reaches the capillaries. The current idea is that in a constricted area the blood-pressure rises and increases the circulation through it. This doctrine



has received support from the belief that the hæmomanometer with its high readings in such cases records the blood-pressure pure and simple. Sclerosed vessels are more liable to hypertonus than normal ones. Hypertonus disappears when deleterious substances disappear; prolonged hypertonus leads to permanent thickening of the arterial wall.

In addition to the above, the grounds upon which Russell denies that the hæmomanometer affords a true index of blood-pressure when the vessels are thickened are as follows:—

1. He accepts the physiological teaching that the normal brachial blood-pressure in man is somewhere about 100-120 mm. Hg; it rises after violent exercise to about 140 mm. Hg, and this difference of 20 mm. represents more or less the reserve power of the heart. How is it possible then to reconcile with this a doctrine that in disease the heart is capable of exerting pressure equal to 200 or 250 mm. Hg?

2. In clinical work, in cases of interstitial nephritis, for instance, very high manometric readings occur. These may go on rising until just before death, when the heart is obviously failing; on the other hand, they may be reduced by measures which diminish hypertonus, and the softening of the artery which goes along with the falling pressure can be detected by the finger. Such high pressures as 300 mm. Hg in the last stage of Bright's disease simply mean that the vessels are growing steadily thicker and their lumens smaller.

3. In the interpretation of manometric readings it must be remembered that the condition of the brachial artery may differ from that of the radial. With a thickened brachial and a soft radial a reading of 200 mm. Hg may be obtained. Occasionally the removal of hypertonus raises the reading from 110 to 120 mm. Hg; the explanation given is that the relief to the heart allows it to beat with greater vigour.

CAUSE OF HYPERTONUS.—The chief cause of hypertonus is the absorption from the bowel of the results of imperfect digestion or stagnation of the intestinal contents; excessive (especially proteid) food, improper food, and alcohol also conduce to it. Russell also recognises the existence of a normal arterial abdominal reflex, whereby the flux of blood to the splanchnic area is balanced by a constriction of the systemic vessels. This reflex constriction may be accentuated by the character of the food ingested, and by the existence of arterial sclerosis. Such a conception of arterial hypertonus as has been outlined links together a variety of morbid conditions. Besides explaining the genesis of arterio-sclerosis and the consecutive renal and cardiac changes which it produces, it accounts for transitory cerebral disturbances—hemiparesis, numbness in a limb, aphasia, etc., and for some cases of angina pectoris. A specially important rôle is assigned to the arterial abdominal reflex in producing attacks of angina.

The treatment of hypertonus is in the first place directed towards removing any form of digestive disturbance, and restricting the diet within moderate limits, particularly as regards nitrogenous food. In the second place, vaso-dilator drugs should be used. Erythrol tetranitrate is the most active of these; among others are spiritus ætheris nitrosi, potassium iodide, atropine, stramonium, valerian, paraldehyde, phenacetin, trional. Digitalis and strophanthus should be added if the heart is feeble.



**Arterio-Sclerosis.**—In spite of the amount of research which has been devoted to the subject, much still remains to be learned concerning arterio-sclerosis. Pathologists are by no means agreed as to the nature of the different vascular changes found, and clinicians for the most part continue to apply the name to any thickened condition of the arteries, the thickening being judged of mainly by the examination of the radial artery, without much reference to the ultimate nature of the morbid process. Russell, however, has done good service in clearing the ground in one direction, and the distinction which he draws between tonic contraction and hypertrophy of the media on one hand, and such forms of thickening as atheroma on the other, has attracted much notice. (See ARTERIAL HYPERTONUS.)

It is generally agreed that arterio-sclerosis, using the term to mean a diffuse thickening and rigidity of the arteries, occurs secondarily to the presence of deleterious substances in the blood. There is no such general agreement as to the part which is played by high blood-pressure. Some look on the high blood-pressure of arterio-sclerosis as due to the same agents—toxic materials—as cause that disease; others assert that the toxins produce arterio-sclerosis indirectly by raising the blood-pressure; while others again think that the toxins act directly on the vessel wall, causing thickening, and that the high blood-pressure is secondary to this. Stengel holds that in the early (pre-sclerotic) stage of arterio-sclerosis, the blood-pressure, so far from being permanently raised, is actually subnormal, with occasional rises. Huchard, on the contrary, believes in a pre-sclerotic stage of hypertension; this he regards as curable, the later, sclerotic, stage as incurable. Clifford Allbutt divides cases of arterio-sclerosis into three groups:—(1) Hyperpiesis, due to high blood-pressure extending over a number of years; (2) toxic; (3) involutional. Broadly, he associates with the hyperpietic cases tearing and shearing stresses which leave microscopic evidence of their action on the vessel wall, and hypermyotrophy; with the toxic cases thickening of the intima, but no hypertrophy of the muscular coat; with the involutional cases calcification of the media. High pressure is characteristic of hyperpiesis, not of the other two; if it can be permanently abolished the hypermyotrophy may disappear. This conception appears to harmonise to some extent with the opinions of Dr. Russell.

The factors which are believed to play a part in the production of arterio-sclerosis are:—(1) Heredity. (2) Toxic causes—gout, lead-poisoning, syphilis, alcoholism, nicotine poisoning, deleterious substances arising from excessive or abnormal metabolism of the proteids of the food (purin bodies in particular), caffeine, and theobromine. (3) Physical or mental strain. (4) Infectious diseases, especially rheumatism and typhoid fever. Thayer has drawn special attention to the comparative frequency with which arterio-sclerosis follows typhoid fever:—“Between the ages of 10 and 50 years 48·3 per cent. of old typhoid patients show palpable arteries, as compared with 17·5 per cent. among ordinary, healthy individuals.” It is not improbable that the part which is played by alcohol in producing arterio-sclerosis has been to some extent over-estimated. Cabot found arterio-sclerosis in only 6 per cent. of chronic alcoholics, and a history of alcoholism in only 21 per cent. of (post-mortem) cases of arterio-sclerosis.

Although typically a disease of the later decades, arterio-sclerosis may occur in children. Fremont-Smith's study of the subject points



to the conclusion that the chief causes are heredity, individual predisposition, congenital syphilis, and infectious diseases. Probably the importance of syphilis has been over-, and the importance of acute infections under-rated.

EXPERIMENTAL ARTERIO-SCLEROSIS.—Attempts have been made to throw light on the nature of the disease by experiment on animals. The main result which has been brought out is to demonstrate that injections of adrenalin will produce, with a fair degree of certainty, degenerative changes in the rabbit's aorta. It has been shown that ligature, compression, and local inflammation of vessels caused by mechanical or chemical means produce local thickening in the walls of the vessel, but the experiments which have been made by injecting poisonous substances bear more resemblance to the conditions obtaining in human pathology. Alcohol, lead, and bacterial poisons have given contradictory results: lead sometimes produces multiple aneurismal dilatations; Klotz compares the effect of diphtheria toxin to that of adrenalin, while injections of streptococci and *b. typhosus* cause endothelial proliferation. In the case of adrenalin the experiences of different workers have been fairly congruent. Two or three weeks after a rabbit receives injections of adrenalin changes appear in its aorta. The earliest damage is found in the media; the cells necrose, and the elastic fibres degenerate. There is no primary change in the intima. Ultimately a fusiform dilatation is developed. These experiments are interpreted as illustrating the effects of high blood-pressure. The adrenalin is distributed throughout the body, yet its effects are only apparent in the aorta, where the pressure is highest. Similar, though milder, changes are produced by barium, digitalis, and nicotine. If the action of adrenalin on blood-pressure be annulled by the simultaneous administration of nitrites, the arterial change is less extensive, but does not differ in character. Iodides do not seem materially to modify the action of adrenalin on the vessels.

CLINICAL VARIETIES OF ARTERIO-SCLEROSIS.—More fruitful of practical results, perhaps, than investigations as to the ultimate nature of arterio-sclerosis has been the recognition of certain symptom-groups due to vascular changes.

Stengel points out that while normal senile arterio-sclerosis is a general and uniform process, accompanied by gradual failure of the organic functions, pathological arterio-sclerosis, though beginning as a general disease, tends in the long run to affect one organ prematurely; hence in its clinical manifestations cardiac, renal, or cerebral symptoms may predominate. It is in this stage that the condition is generally diagnosed for the first time, but its early detection is as important as the early detection of pulmonary tuberculosis. Stengel divides the disease into three stages:—(1) A preliminary stage; (2) a middle period, during which the arterial thickening is easy to recognise, and secondary organic changes are beginning to discover themselves; (3) a final stage of failure of the circulation, of organic failure, and of terminal infection.

During the first stage the symptoms are indefinite. The blood-pressure is not permanently high, though temporary rises may occur. The patients suffer from loss of vigour, from mild neurasthenia, from dryness of the skin or excessive perspiration. The renal equilibrium is disturbed, and reduced excretion of urine alternates with polyuria. There is often digestive disturbance and loss of weight. Three main clinical types of case occur:—(1) A nutritional type, in which loss of



vigour, emaciation, and pallor ("pseudo-anæmia") from vascular contraction are the leading symptoms. (2) The neurasthenic type, in which the symptoms of nervous exhaustion are predominant (*v. infra*). (3) The nervous type, accompanied by neuralgia, migraine, tinnitus, vertigo, and muscular weakness.

In the second stage the signs of arterio-sclerosis are well marked. The vessels are thickened, the blood-pressure is raised, the arterial second sound is accentuated, there is a marked tidal wave in the pulse-tracing, and the sphygmometer shows high pressure. During this period Stengel classifies cases according to which organ is most affected—cardiac, aortic, renal, intestinal, pancreatic, arterio-capillary, cerebro-spinal. In cardiac cases the heart is irregular; there may be angina. In aortic cases there are signs of aortic degeneration and dilatation. In the renal type we find evidences of chronic interstitial nephritis; cylindroids occur in the urine long before casts can be detected. In the arterio-capillary type the vascular thickening overshadows the other features.

**ARTERIO-SCLEROSIS OF THE SPLANCHNIC VESSELS.**—Stengel describes the features of intestinal arterio-sclerosis as atrophy of the mucous membrane, sudden attacks of painful obstruction, and chronic colitis. This symptom-complex has also been carefully studied by Buch, of Helsingfors, who gives its leading symptoms as follows:—In simple arterio-sclerotic colic the patient is usually over forty, and suffers from frequently-recurring attacks of severe epigastric pain, the individual attacks being of short duration. The pain is evoked by exertion or emotion, and is associated with tenderness over the abdominal aorta. In a second group of cases the colic is complicated by the existence of granular contracted kidney, and in a further group by angina pectoris. The chief diagnostic features of the seizures are their suddenness and frequency (many during the twenty-four hours), their association with mental shock or physical strain; and the absence of any digestive disorder to account for them. Arterio-sclerotic colic may occur as an early symptom of arterio-sclerosis; usually, however, by the time it develops, general vascular thickening can be made out.

**ARTERIO-SCLEROSIS OF THE NERVOUS SYSTEM.**—Cimbal proposes the following grouping of cases, based chiefly on the views of German clinicians:—(1) Neurasthenia. (2) Cerebral destructive form, the most definite type being pseudo-bulbar palsy. (3) The results of (1) and (2)—apoplexy, and late epilepsy. (4) Spinal arterio-sclerosis. (5) Angio-sclerotic neuritis.

Of these five groups the first and last are the best defined.

**ARTERIO-SCLEROTIC NEURASTHENIA.**—The symptoms on the whole resemble those of ordinary neurasthenia, but come on more suddenly, without definite cause, and without any of the minor prodromal symptoms which usually herald an ordinary attack of neurasthenia. The patients are generally over middle life. Foremost among the symptoms is chronic headache, which is exacerbated by exertion and by the use of alcohol. This aggravation of the symptoms by alcohol is somewhat characteristic of arterio-sclerotic neurasthenia. Other pronounced symptoms are a feeling of swaying and insecurity in walking, disturbed sleep, and mental depression. Both physical and mental work rapidly cause a feeling of exhaustion. Cimbal lays stress on the following as aids to diagnosis:—The face tends to flush and pale by turns, and in the later stages is congested. There is no history, hereditary or personal, of psychoses or previous neurasthenia, as in most forms of functional nerve



disorder. Arterio-sclerotic neurasthenia sets in without cause or warning. The smallest quantity of alcohol aggravates all the symptoms. Some cases closely resemble an early stage of general paralysis: lumbar puncture (no cells in the cerebro-spinal fluid) will decide this point.

INTERMITTENT CLAUDICATION.—This condition (also called *Dysbasia angio-sclerotica* and *Intermittent Limp*) has been especially studied by Erb. Its leading features are—(1) pain in the legs brought on by walking, disappearing after a brief rest, and recurring when walking is resumed; (2) defective circulation in the limbs; (3) a tendency to progress to senile gangrene. The chief symptoms of typical cases are a feeling of tightness, or stiffness, or actual pain in the legs, *paræsthesiæ*, and vaso-motor disturbances—coldness, pallor, cyanosis, or heat and redness—in the feet, all of which occur on walking, and rapidly progress to such an extent that the patient has to pause for rest after he has walked for a quarter of an hour or so. After a short rest the symptoms abate completely, but when the patient sets out again the scene is re-enacted. The anterior and posterior tibial vessels are either imperceptible, or extremely small and contracted, showing evidence of arterio-sclerosis. These vascular and circulatory signs are essential to the diagnosis. The disease is usually bilateral; sometimes pulsation is absent from the popliteal and femoral arteries also. In addition to the above vascular disturbance there may be actual senile gangrene. Males are chiefly affected; the disease is most common in the fourth and fifth decades, and it is more frequently met with among the well-to-do than the labouring class. Excessive use of tobacco and exposure to cold are said to be the most important causes. Intermittent claudication is relatively common in Russia. Idelsohn regards cold as the chief etiological factor.

TREATMENT OF ARTERIO-SCLEROSIS.—The line of treatment generally advocated includes the regular use of warm baths, moderate amounts of exercise, and gentle massage. When obesity is present it should be reduced by diet, not by excessive exercise. The diet in arterio-sclerosis should consist largely of milk, vegetables, and farinaceous foods. Huchard advises that it should as far as possible be free from salt (see *DECHLORINATION*). Tea, tobacco, and alcohol should be used sparingly or altogether prohibited (see *PURIN-FREE DIET*).

Apart from these general measures the chief remedies employed are those which favour elimination, and drugs which lower the blood-pressure. As diuretics, diuretin and nitrites are advised by Huchard; benzoates by Barr. Diaphoretics and saline aperients should also be given; among Spas recommended Harrogate may be mentioned. Iodides continue the most popular drugs; next to them Barr places thyroid as a depressor of blood-pressure. The usual dose of iodide of potash is from 2 to 5 grs. thrice daily. Huchard recommends a course of iodide and nitrite alternately, thus: Potassium iodide is given to the amount of 15 to 30 grs. daily for the first twenty days of the month; during the last ten days the patient takes 2 drops of 1 per cent. trinitrin night and morning. Erlenmeyer's iodide cure consists in giving 4 grs. of sodium iodide and 4 grs. of potassium iodide daily, increasing by 8 grs. of the mixed drugs every fourth day, until by the thirty-sixth day the patient is taking 80 grs. To each dose 20 grs. of sodium bicarbonate is added. This method of administration prevents iodism, and should be persisted in until the patient has had from 1500 to 2500 grs. of iodide. A shorter prophylactic cure should be undergone annually thereafter.



In the later stages of arterio-sclerosis, when the heart is failing, digitalis is required.

In ARTERIO-SCLEROTIC NEURASTHENIA rest is essential, and no active measures (*e.g.* hydrotherapeutics) are advisable. For sleeplessness bromides are the best drugs. Veronal is unsafe. In senile insomnia a combination of morphine (gr.  $\frac{1}{8}$ ) and veronal (grs. 4) may be used.

ARTERIO-SCLEROTIC COLIC.—Diuretin in doses of from 20 to 30 grs. daily is said to be the most useful drug, and may completely ward off attacks. Next come strophanthus and the iodides. Warm fomentations should be kept applied to the abdomen for several hours in the day; abdominal massage should be tried when the blood-pressure is high.

INTERMITTENT CLAUDICATION.—The treatment consists in giving up tobacco, and using all means of preventing exposure to cold. Cardiac tonics and iodides should be given, and the legs should be treated with galvanism.

LITERATURE.—CLIFFORD ALLBUTT. *Brit. Med. Journ.*, Dec. 22, 1906.—HUCHARD. *Bull. de l'Acad. de Méd. Paris*, Jan. 21, 1907.—THAYER. *Amer. Journ. Med. Sci.*, Mar. 1905; *Journ. Amer. Med. Assoc.*, Sept. 10, 1904.—HEINEMAN. *Med. Rec.* (New York), April 27, 1907.—FREMONT-SMITH. *Amer. Journ. Med. Sci.*, Feb. 1908.—CABOT. *Journ. Amer. Med. Assoc.*, Sept. 10, 1904.—KLOTZ. *Brit. Med. Journ.*, Dec. 22, 1906.—HEUBNER. *Ergebnisse d. inner. Med. u. Kinderheilk.*, Bd. i. 1908 (general review of experimental work).—CIMBAL. *Idem*, Bd. ii. 1908.—STENGEL. *Amer. Med.* (Phila.), Jan. 2, 1904; *Proc. Phila. Med. Soc.*, 1906.—BUCH. *Arch. f. Verdauungsk.*, Bd. x. Heft 5 u. 6, 1904.—ERB. *Münch. med. Wochensch.*, May 24, 1904.—IDELSOHN. *St. Petersburger med. Wochensch.*, Jan. 22, 1905.

**Atmocausis.**—DEFINITION.—Vaporisation or atmocausis of the uterus is the application of steam to the interior of that organ for the purposes of arresting hæmorrhage and of modifying the mucous membrane; it is cauterisation of the endometrium by means of steam: and the steam may be applied either by means of a double catheter, whose central tube carries in the steam, which comes in contact with the mucosa, and escapes again through the outer tube, which has a number of fenestrations in its intra-uterine extremity (*atmocausis* proper, from Gr. ἀτμός, smoke or vapour, and καῦσις, a burning); or by a non-fenestrated catheter, which becomes steam-hot, the heat being applied to the uterus through the wall of the outer tube, while the steam itself does not escape into the cavity of the organ (*zestocausis*, from Gr. ζεστός, boiling, hot, and καῦσις, a burning).

HISTORY.—Although atmocausis was introduced into gynecological practice during the closing years of the nineteenth century, Sneguireff having used it in Moscow in 1894 (*Zentralb. f. Gynäk.*, xix. pp. 74, 870, 1895) and demonstrated it at the International Medical Congress held there in 1897 (*Zentralb. f. Gynäk.*, xxi. p. 1161, 1897), yet its establishment as a recognised operative procedure in the treatment of the diseases of women belongs to the twentieth century. It is not referred to in the *Encyclopædia Medica*. Sir Alexander Simpson reported (in May 1900) the results of fourteen cases in which he had used the atmocautery in Edinburgh (*Trans. Edin. Obstet. Soc.*, xxv. p. 131, 1900), and described and demonstrated its method of application; in this way it was brought under the notice of British gynecologists. But, before this date, Dr. Ludwig Pincus of Danzig had done much to introduce the procedure into Germany (*Zentralb. f. Gynäk.*, xix. p. 284, 1895; xxi. p. 190, 1897; xxii. pp. 256, 582, 1019, 1898; xxiii. 113, 352, 1008, 1010, 1899), and other workers in that country had reported, favourably or unfavourably,



upon the matter (*e.g.* Panecki, *Zentralb. f. Gynäk.*, xx. p. 463, 1896; Kahn, *ibid.*, xx. p. 1233, 1896; Pit'ha, *ibid.*, xxi. p. 652, 1897; Schick, *ibid.*, xxi. p. 695, 1897; Baruch, *ibid.*, xxii. p. 113, 1898; Kahn, *ibid.*, xxii. p. 618, 1898; Otto von Weiss, *ibid.*, xxii. p. 636, 1898; T. H. van de Velde, *ibid.*, xxii. p. 1409, 1898; Dührssen, *ibid.*, xxiii. p. 292, 1899; Gerich, *ibid.*, xxiii. p. 557, 1899; Beuttner, *ibid.*, xxiii. p. 993, 1899; Stapler, *ibid.*, xxiii. p. 1000, 1899; Pit'ha, *ibid.*, xxiii. p. 1011, 1899; H. A. V. Guérard, *ibid.*, xxiii. p. 1081, 1899). Since the beginning of the present century Pincus has continued to advocate atmocausis strongly, and has brought together in his book (*Atmokausis und Zestokausis* (Wiesbaden), 1903, 1906), and in a number of monographs (*e.g.* *Samml. klin. Vortr.*, Nos. 238, 261, 262, 1899, and No. 417, 1906), all the evidence in favour of it and all the details regarding its indications and mode of employment. There have been others in Germany, however, who have pointed out that the procedure is not free from danger and that it has disadvantages, and among these writers may be named Pfannenstiel (*Verhandl. d. deutsch. Gesellsch. f. Gynäk.* (Leipzig), p. 463, 1906), P. Meyer (*Zentralb. f. Gynäk.*, xxxi. p. 174, 1907), and H. Cramer (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 346, 1908). In Great Britain there has been comparatively little enthusiasm evinced for the operation of atmocausis. Simpson (*loc. cit.*), indeed, was appreciative, and Macnaughton Jones spoke with some favour of the procedure; but Campbell (*Brit. Med. Journ.*, ii. for 1901, p. 964) was critical, and Blacker (*Journ. Obstet. and Gynec. Brit. Emp.*, i. p. 488, 1902; iii. p. 444, 1903) urged greater discrimination in the selection of suitable cases. Pincus, indeed, still holds (*Zentralb. f. Gynäk.*, xxx. p. 379, 1906) that if the method be cautiously employed in carefully chosen cases it is safe, painless, and efficacious ("ungefährlich, schmerzlos und wirksam"); but it may be said with some confidence that atmocausis has not, and will not, supplant, although it may, in rare cases, supplement the use of the curette. In British gynecological practice, at any rate, curettage maintains its place as one of the most commonly employed and generally successful operations in diseased conditions of the endometrium; atmocausis is occasionally used in hospitals or nursing homes and in special cases.

DESCRIPTION OF THE OPERATION.—The *requisites* are (1) a Pincus's kettle or boiler for generating the steam, strong enough to resist a pressure of three atmospheres, fitted with a thermometer, dynamometer, and safety-valve, provided with an exit tube for the steam, and heated by means of a spirit-lamp or Bunsen burner; (2) an intra-uterine two-way metal cannula or catheter (with a protected handle fitted to it at an angle) with openings in it to allow the steam to escape in atmocausis proper, or entirely closed (non-fenestrated) in zestocausis, and with a protective covering (of wood or indiarubber) for the part which comes in contact with the cervical canal; (3) two volsellæ to fix or pull down the cervix; (4) specula for protecting the vaginal walls; and (5) cervical dilators (*e.g.* Hegar's). It is best to have a return tube to bring the steam away from the uterine interior, and not to allow it to escape into the vagina. Zestocausis is now scarcely ever employed, and may be neglected in the description of the operative procedure.

The patient is prepared as for a curettage, and an anæsthetic is usually given, although it has been claimed that the operation is painless and can be performed without chloroform. The actual application of the steam to the uterine interior should always be preceded by a careful bi-manual examination to detect traces of pelvic inflammation, and by



dilatation of the cervical canal, either at the time by Hegar's bougies or overnight by a tent. A preliminary curettage may or may not be performed. The cervix is drawn down by volsellæ, the length of the cavity measured with a sound, the interior washed out, and the vaginal walls and vulvar ring are protected from the heat by specula. The steam is made to pass through the tubing and cannula so as to warm the parts of the apparatus. The cannula is introduced into the uterus with the steam shut off; it is then turned on, and the steam is allowed to play on the surface of the cavity for ten, twenty, or thirty seconds (or longer in special cases) at a temperature of 212° to 239° F. (100° to 115° C.); and the tube is moved about in the uterus to bring the whole mucous membrane under the cauterising influence. The returning steam and water come away through the indiarubber tubing and do not scald the vagina of the patient or the hands of the operator. A small plug of iodoform gauze is placed in the cervical canal after the cannula has been withdrawn, and the vagina is loosely packed with gauze. The after-treatment is the same as for curettage, the patient being kept in bed for a week and getting vaginal douches till the discharge and shreds of sloughing tissue have all come away. It is probable that the heat of the steam when it is actually in contact with the vaginal mucous membrane is never above 212° F., and does not often reach that level, for some heat is lost in conveyance.

RESULTS OF ATMOCAUSIS.—The results of uterine vaporisation have been found to differ in a rather surprising fashion. The ordinary result (and that which it is generally wished to obtain) is destruction, regular and uniform, of the superficial part of the uterine mucosa, followed by regeneration of the membrane in a normal condition. It must be admitted, however, that the necrosis is not always uniform, that the new mucous membrane may sometimes be atrophic, and that, in rare instances, complete destruction of the lining membrane with consequent obliteration of the cavity of the organ has followed vaporisation. These divergent results cannot always be accounted for by differences in the temperature of the steam or in the length of time of its application. The more serious results may perhaps be due to excessive contraction of the uterus which causes the organ tightly to grasp the atmocautery, or by the latter becoming steam-hot and acting as a zesto-cautery. It may be added that obliteration of the uterine cavity is, in a certain group of cases, the result which it is desired to obtain.

CONTRA-INDICATIONS.—The contra-indications to vaporisation of the uterus are, speaking generally, the same as to curettage; but special emphasis may perhaps be laid upon the presence of recent or old inflammatory changes in the pelvic peritoneum or cellular tissue or in the uterine annexa, for in such a case the risk of lighting up fresh inflammation is very considerable. It is also contra-indicated in puerperal sepsis which has become general, and when the uterus contains submucous fibroids or malignant neoplasms, but it constitutes a valuable palliative means of treatment in inoperable cancer. It is not so suitable for young women as for those near the menopause or older than forty-five. The *dangers* arising from the use of the atmocautery are similar to those in curettage, viz. peri-uterine inflammation, perforation of the uterus, an excessive degree of atrophy of the organ, and the production of abortion (in pregnant patients); but, in addition there are the special risks of causing obliteration of the uterine cavity (in the cases in which this end is not aimed at) and of leading to stenosis or atresia



of the cervix. There is also the danger of septic infection during the separation of the intra-uterine sloughs.

INDICATIONS.—It is a somewhat difficult matter to define exactly the cases in which vaporisation should be employed; and gynecologists differ widely in the frequency with which they make use of it and in the kind of case which they regard as suitable. In British practice, however, it may be stated generally that the atmocautery is not thought of until curettage has failed; but if we cast our net wide, as some of the continental gynecologists do, we may include the following morbid states:—(1) Endometritis, glandular, but more especially the interstitial variety, in which it may be hoped that the atmocausis will check the hæmorrhage and ameliorate the dysmenorrhœa (if present); (2) Climacteric and pre-climacteric hæmorrhages for which there is no clearly defined cause such as myomata or malignant neoplasms; (3) Hæmophilia in women (a rare occurrence) when the disease shows itself in the form of uterine hæmorrhage; (4) Interstitial fibro-myomata of the uterus, for the purpose of checking the bleeding, but such a result cannot be guaranteed; and (5) Systemic diseases, such as phthisis, contracted pelvis, and other morbid states in which pregnancy is to be feared, when atmocausis is used to cause complete obliteration of the uterine cavity, and consequent sterility (but atmocausis is sometimes neither effective nor safe in such cases as Meyer's report (*loc. cit. supra*) proves. Beyond these indications, there are others, such as puerperal sepsis in its early and localised stage, cancer of the cervix (as a palliative measure), subinvolution, and to cause closure of the cavity of the body of the uterus after amputation of the cervix (*e.g.* for cervical cancer); but evidence regarding the efficacy of atmocausis or zestocausis in these directions is not forthcoming in sufficient amount or with the requisite certainty to enable us to express an emphatic opinion. The last word on the subject would appear to be, that in the vast majority of cases curettage holds its ground as the operation of election, but that atmocausis is of some value when curettage fails (especially in hæmorrhages at the menopause, with no well-defined pathological state as a cause), when there is a suspicion of hæmophilia, and when artificial sterilisation is clearly indicated (*e.g.* in women suffering from incurable diseases).

LITERATURE.—A good account of the literature of the subject is contained in Pincus's work (2nd ed. 1906), and in Blacker's article (*loc. cit. supra*), up to date of its publication (1902). Some recent articles of importance, not already referred to, may be named here:—BAISCH. *Zentralb. f. Gynäk.*, xxx. p. 16, 1906.—FUCHS. *Monatssch. f. Geburtsh. u. Gynäk.*, xxiv. p. 487, 1906.—HUGEL. *Vereinsb. d. pfälz. Aerzte*, xxiii. p. 170, 1907.—WEISSWANGE. *Zentralb. f. Gynäk.*, xxxii. p. 296, 1908; and FRANKENSTEIN. *Monatssch. f. Geburtsh. u. Gynäk.*, xxviii. p. 396, 1908.

### Bier's Method of Treatment by Hyperæmia.

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PASSIVE CONGESTION.—*Active Hypercæmia.*—Bier's method of treatment by passive congestion is one which consists in augmenting the inflammatory reaction by interfering with the blood return from the site of disease. It is capable of application to a wide variety of ailments, such as those where acute or chronic inflammation is present. As it is based on the fundamental conception that the inflammatory reaction



is in the main a beneficial process, it may also be applied to any case where it is desired to stimulate wound-healing. Thus, for example, it can be used where delayed union after an osseous fracture is present. It is also found to be of great service as a prophylactic form of treatment in cases of recent lacerated wounds which have been contaminated at the time of the accident. It is necessary, in order to practise Bier's treatment, to possess a clear conception of the true significance of the inflammatory process. For many years most pathologists have maintained that inflammation and repair were the manifestation of an identical process, which only varied in degree according to the severity of the irritant to which they were the response. It is only, however, since Bier's method of treatment has become so widely practised by surgeons that the majority of medical men have become converted to this view. This variation between the pathological and clinical opinion has been largely due to the confusion of cause and effect; the pronounced inflammatory reaction called forth in response to an intense micro-organismal irritant being credited with the harmful effects which the bacterial poison caused. Holding the view that the presence of inflammation was in itself harmful to the organism, such remedies as the ice-bag were often used to carry out an anti-phlogistic method of treatment. When the cardinal phenomena of inflammation are examined and compared with those seen where repair is occurring, it will be observed that the two processes are essentially identical and only differ in degree. When repair takes place in a vascular organ, there is observed early a pronounced engorgement of blood-vessels round the wound. When inflammation is present, a similar hyperæmia causes the classical *rubor*. In the same way, when all the local vascular and cellular phenomena are studied, they are found to correspond.

The method of treatment by augmenting the inflammatory reaction for the cure of disease is of course not new. For long such means for inducing local hyperæmia as the poultice and the blister have been used in surgical practice. Neither was the very technique adopted by Bier in the treatment of his cases a novel one when he introduced it, for just as carbolic acid was used to promote the healing of wounds long before Lister enunciated the principles of antiseptic surgery, so were constricting fillets used to interfere with the return of blood from a part in order to favour healing. What was new, however, was the fundamental conception underlying the practice, and on this account it will remain for ever as "Bier's treatment by hyperæmia."

TECHNIQUE. — Where passive congestion is employed it can be carried out in one of two ways. A rubber bandage may be applied lightly on the cardiac side of the lesion, and by this means the return of venous blood to the part will be interfered with and venous engorgement produced. On the other hand, cupping-glasses may be used, which by their suction engorge the vessels of the part to which they are applied. This latter method, which is a more recent modification of Bier's method of treatment, was introduced by his assistant Klapp. Active hyperæmia or arterial congestion is best produced by the application of dry heat by means of hot air. Superheated dry air is the best means, because higher temperatures can be tolerated when it is used. Thus, for example, Bier mentions that he was able to hold his forearm in superheated dry air at a temperature of 105° C., whereas in hot water only a temperature of 44° C. could be borne.

PASSIVE CONGESTION BY MEANS OF THE RUBBER BANDAGE.—This



method of treatment is found to give excellent results in many cases. As will be detailed later, it may be used in cases of acute suppuration, or where more chronic infection has occurred. The best material which can be used is a soft, thin, elastic rubber bandage. This may be obtained from any instrument-maker in rolls of varying width, from which pieces can be cut off as required. On the bandage being applied to a limb, it should be of a length that will enable it to go at least one-and-a-half times round its circumference. Before applying the bandage, the site of the disease is carefully inspected and cleansed, and a sterile dressing applied loosely over it. It is of importance that this latter point be carefully attended to, as the œdema which follows the application of the bandage might otherwise cause the bandage covering the dressing to become too tightly applied when the limb is swollen.

The situation in which the bandage should be applied varies with the different lesions being treated. It will be found, however, that the best results are obtained when the constriction is put on at some considerable distance from the site of disease. Thus, for example, in cases of severe whitlow, the constricting fillet should be applied around the lower part of the upper arm. Where the disease is situated in the region of the foot or ankle, the constriction can best be applied around the thigh.

The method of application which is found to be most comfortable to the patient is that where a portion of soft flannel or boracic lint intervenes between the rubber bandage and the skin. When the boracic lint has been applied loosely around the part to be constricted, the rubber bandage is then rolled round the limb, which has been previously placed in the position in which it is afterwards to remain. The best method of fixing it is by the simple device of fixing the tail to the previous turn by a piece of adhesive plaster.

It is of very great importance that the proper degree of constriction should be procured, as on it entirely depends the success of the treatment. It is only by experience that a correct standard can be arrived at, but there are certain rules which should always be adhered to. The bandage should never be applied so tightly as to obliterate the pulse beyond. It should never cause the limb to become either pale, cold, or of a dark, cyanosed appearance. The most certain guide that can be given as to the proper degree of constriction is the effect it produces in relieving pain. The properly applied bandage should never cause pain, it should always lead to the relief of pain. When the bandage has been properly applied, the superficial veins are seen to become slowly engorged. The limb will be found later to become swollen and somewhat œdematous. In some cases, where an acute infection is being treated, the amount of swelling is pronounced, and may be accompanied by the presence of *bullæ*, the inflamed area being also wider than before treatment was commenced. When this is seen for the first time by one not familiar with the effects of this treatment, it may give rise to alarm, and the bandage be in consequence removed. There is, however, no occasion for doing this, for, as Bier pointed out in his original papers, such an appearance is indicative of successful, not unskilful treatment.

When the patient is questioned as regards his sensations, he will often state, that in addition to the relief of pain that the treatment has brought about, he feels a comfortable glow at the site of the disease.



LENGTH OF TIME DURING WHICH THE BANDAGE SHOULD BE APPLIED.—In cases where acute infection is being treated, it is to be advised that it be kept on for as long as twenty hours out of the twenty-four. It is not necessary that the patient be kept under observation during this time: a method that is often adopted is to apply the bandage about 10 o'clock in the morning. When the inflammation is one involving an upper extremity, the patient may perfectly well be sent home. He is told to report himself to his medical attendant in the evening, about 6 o'clock, when the bandage is taken off, then reapplied. He is then sent home with the instructions that he is to wear it during the night, and take it off about 6 o'clock in the morning. Should the bandage, however, feel uncomfortable and unduly tight, or should the part become more painful, he is instructed to remove it before this time. When the patient is seen on the following morning at 10 o'clock, the bandage is again reapplied, and a similar line of treatment carried out as was previously adopted. As convalescence approaches, the interval during which the bandage is worn may be greatly shortened, until at length it is dispensed with entirely.

The introduction of passive hyperæmia may arrest infection before it has gone on to suppuration, or even where suppuration has occurred, resorption may take place. It has been the experience of every surgeon who has practised this form of treatment that cases have come under his care where a commencing whitlow is diagnosed. Before Bier's treatment was introduced, these would have been treated by prompt and free incision; by the use of Bier's treatment a rapid improvement has been brought about, and a cure obtained without the necessity of an incision being made. These cases are, however, the exception, as in the majority, when seen twenty-four hours after the bandage was originally applied, the patient is found to be in improved health, to have less pain in the wound, and to have slept well, but examination of the local lesion shows evidences of the accumulation of pus. When such is the case, it is treated by prompt evacuation, as was formerly practised. In practising Bier's treatment in cases of acute infection, it should never be used as an excuse to avoid the evacuation of pus by incision, when the presence of such is diagnosed. The incision which is necessary where Bier's treatment is being practised is a much smaller one. A puncture wound, to permit of evacuation, is often all that is required. It is also not necessary to introduce drainage-tubes. The use of Bier's treatment, where suppuration is present, causes a more abundant discharge to take place. This discharge, however, will be found to cease earlier, and the amount of sloughing of tissue with which it is associated is much less. In the earlier cases that Bier treated, he found that, where cases of teno-synovitis and osteomyelitis were treated by passive congestion, sloughing of the tendons did not take place so readily, the amount of osseous necrosis was not so extensive, and the *sequestrum* was more rapidly exfoliated.

The regions in which the bandage may be used are more especially the extremities, and particularly the lower parts of these. Where the hip-joint or shoulder-joint are to be treated, however, this may be done by so arranging that the constriction ring is applied as high up as possible, tapes round the trunk being used for this purpose. Obstructive hyperæmia has also been practised where the lesion is one involving the head and neck. To do this, the bandage should be wound loosely round the lower part of the neck, or, if desired, an elastic neck-band can be obtained, which is specially made for this purpose.



The technique to be practised where it is desired to induce obstructive hyperæmia in diseases of the testicle is as follows:—A piece of thin rubber drainage-tubing is applied around the base of the scrotum, with a piece of boracic lint intervening between it and the skin. Where the ends of the tubing cross, these are tied with a piece of tape or caught in a clip. To prevent slipping, it will be found necessary in some cases to fix this rubber ring by means of tapes passing round the pelvis.

The *contra-indications* to the use of Bier's treatment are few. As has already been mentioned, it was never the intention of the introducer of this method to advise that it be used in preference to incision, where acute abscesses are formed. In cases where extensive lymphangitis and lymphadenitis have taken place, it is usually found impossible to apply the constriction above the level of the site of the disease. In these cases the bandage, applied in the usual way, will often be found to give an excellent result, but in some of them pain from direct pressure is found to be produced. It is obvious that where septic thrombosis has occurred in a vein, the use of Bier's bandage would be attended with an increased danger of septic embolism.

OBSTRUCTIVE HYPERÆMIA BY MEANS OF KLAPP'S SUCTION-CUPS.—This method, which has been specially worked out by Klapp in Bier's clinique, has many advantages. It is a form of treatment which is now especially adopted in cases where Bier's bandage cannot be conveniently applied. There can now be obtained from the instrument-makers a large number of different cups, made to fit the different parts of the body. The principle of construction of these is identical. They all consist of a glass bell jar, with a broad everted rim, and a neck on the summit of the convexity, which is connected with a rubber tube. In the smaller jars a negative pressure is created by compressing the rubber bulb at the end of the tube. In the larger jars this suction is brought about by using an exhaust pump. The regions in which Klapp's suction-cups are found to be especially useful are the breast, the neck, and the groin. The use of the suction-cup possesses the advantage over the rubber bandage that, in cases where a sinus exists, leading to a buried septic focus, the negative pressure within the bell jar not only leads to an engorgement at the site of disease, but it also, by its suction, draws out the purulent content and cleans the abscess cavity. This is especially manifest in the treatment of cases of carbuncle, where the slough is separating.

The method of application is extremely simple. There are, however, a few points that require to be attended to. A cup is selected which is of a size adapted to the area to be treated. The instrument has, of course, been previously carefully sterilised. The rim is anointed with vaseline before the jar is applied to the skin. If this detail is neglected, unnecessary pain may be caused the patient by the skin catching on the jar when suction is applied. The suction-cup is now held loosely applied, and suction obtained. The suction should be gradually induced. A mistake commonly made with this form of treatment is to use too great a degree of suction, and to develop the same too rapidly, with the result that pain is caused, and hæmorrhage occurs from the capillaries of the granulating wound. Sometimes, owing to the inequality of the surface to which the cup is applied, it is found impossible to develop a partial vacuum, as air gets in at the side of the bell. When this is the case, it is to be recommended that the inequality of the



surface be overcome by surrounding the rim of the bell with a ring of sterile plasticine. When properly applied, the application should be absolutely painless; there should be no interruption of circulation.

The length of time during which the suction-glass should be applied will vary with different individual cases. Bier would recommend that they be applied six times during the day, for five minutes each time, an interval of three minutes or so being allowed between each individual application. It will thus be seen that the time occupied is at the most three-quarters of an hour each day. In some cases, where the degree of suction is not great, a more lengthy application will be found to be well borne, and produce a good result. It is to be remembered, however, that any oedema and hyperæmia that may have resulted must be allowed to disappear before bell be again applied.

*Active Hyperæmia by the Use of Hot Air.*—As has already been mentioned, the application of hot air to a part induces an active or arterial hyperæmia. Where dry, hot air is used, a very high temperature can be comfortably borne. The class of cases for which this treatment is especially useful is where a more chronic lesion is being treated; where, for example, chronic exudate or organising adhesions are present inside a joint. The methods that are adopted in applying hot air to a part are, firstly, by means of the hot air chamber; secondly, by using the hot air douche. In order to carry out either of these means, very simple contrivances may be fitted up. In the case of the former, the treatment may be carried out by simply surrounding the part to be treated with electric lamps, such as are used for ordinary purposes of illumination. These are placed at a distance where a comfortable degree of heat will radiate on to the limb, and are covered with blankets laid over an ordinary "cage." If a more elaborate appliance is desired, this can be made with a wooden box, into which the limb is placed, and into which also a funnel passes, which is connected with a source of heat, such as an ordinary gas flame. Whichever method is adopted, it is essential that great care be taken to avoid burning the limb. This warning is necessary, as when the temperature is gradually raised, a degree of heat may be obtained that is borne comfortably by the patient, but which will be found afterwards to have caused a burn of the second degree.

#### DETAILS IN THE TREATMENT OF SPECIAL CASES BY MEANS OF HYPERÆMIA.

*The Use of Passive Congestion as a Prophylactic in Recent Wounds.*—Bier's treatment has undoubtedly proved of great value in cases of recent severe lacerated wounds. Such statistics as are available would appear to demonstrate that, where this treatment has been adopted, suppuration has occurred less frequently, and healing has taken place more rapidly. The class of case in which it is of especial value is one that is very commonly met with in any large industrial centre. It is that of the adult of the labouring class who has received a severe wound of a limb, into which dirt has been ground. This class of case is one which has always taxed the resources of the medical man, as the difficulty has been to cleanse the part thoroughly, and to prevent the development of widespread suppuration. Where Bier's treatment is to be used, it is recommended that it be instituted immediately the patient comes under treatment. It is applied by means of the rubber bandage, which is



worn for the usual period of twenty to twenty-two hours. The maimed limb is cleansed in the usual way, with this exception, that all powerful chemical antiseptics are carefully prevented from coming in contact with the wounded surface. The wound is simply washed out with an abundant stream of sterilised physiological salt solution. A simple sterile dressing is then loosely applied to the part. The effect of the application of the bandage in this case is similar to that seen where an infective lesion is being treated. The limb becomes engorged and swollen. A fairly abundant sero-sanguineous discharge takes place from the damaged surface. In this discharge there can often be noticed foreign particles which have been buried in the wound.

On the day following the accident, the discharge from the wound will probably be serous in nature, and from the appearance which it presents and the state of the patient, the inference is justified that rapid healing without suppuration will take place. It is advisable, however, that Bier's bandage be used for several days longer. The interval during which it is worn should, however, be reduced in duration. In the class of case where suppuration develops, this will probably be seen to be abundant in amount, but the general effect upon the patient is noticed to be not so severe. Should abscesses form, or cellulitis develop, these are to be treated in the usual way, small incisions being made to allow escape of pus.

*Compound Fractures.*—These cases are particularly suitable for treatment by Bier's method. This is carried out by means of the rubber bandage. The advantage of using this method is that limbs may be saved that otherwise might require to be amputated, and aseptic union occurs in a greater number of cases.

*Acute Infective Abscesses.—Furuncle and Carbuncle.*—These lesions are particularly suitable for treatment by Klapp's suction-cups. The individual furuncle, or where multiple foci are present in a case of generalised furunculosis, are treated by applying the suction-cup for five minutes at a time. Six applications are usually given, an interval of a few minutes intervening between each application, to allow of the cedema and hyperæmia subsiding. The effect of this treatment is that often a furuncle is aborted. Where a definite abscess forms, this is treated by making a tiny incision to allow the escape of pus, and thereafter the use of the suction-cup is resumed.

In no class of case has the treatment been more profoundly modified than in that of carbuncle. The extensive crucial incision which at one time was so commonly used in the treatment of carbuncle is now very seldom practised. The treatment by removing the infective focus by surgical operation may be now entirely abandoned. The justification for this latter line of treatment was that in certain situations, especially the head and neck, death from septic absorption occasionally occurred, and thus it was considered justifiable to cut wide of the disease, although a large raw area was left where healing often occurred extremely slowly afterwards. Although Bier's treatment of these cases by suction-cups cannot claim to have entirely abolished the mortality in cases of carbuncle, the success which has attended its use justifies its preference to any other form of treatment. The method that is practised is to apply a suction-cup of suitable size; one that is large enough to include the swelling and a margin of healthy skin as well. The degree of suction used is that which will cause the swelling to bulge into the glass and induce a distinct hyperæmia of it. On no account must suction be too



powerful. The use of the glass must never be attended with any pain or discomfort. The patient will probably describe the swelling as being comfortably tense; the glass will adhere firmly to the skin. The suction-cup is applied for the usual period of from three to five minutes, and is then taken off, to be reapplied after a short interval for the same period. Six applications are usually found sufficient for the first period of treatment. After twelve hours or so, another series of applications is given. Concomitant with this line of treatment, the usual constitutional remedies are used. The effect of the treatment that has been described is to cause the swelling to become much increased in size. Points of cutaneous suppuration are seen scattered over the surface of the swelling. In certain of the cases these may be punctured, but often they are found to have opened spontaneously, and discharge of pus takes place from them. The continued use of the suction-cup, in addition to inducing hyperæmia of the part, permits the free discharge of pus and slough from the septic core of the carbuncle below. Gradually the whole of the sloughing core is discharged, and the wound presents a cribriform appearance; several small openings, separated by thinned and inflamed skin, leading down to the abscess cavity below. The use of the suction-cup being persisted in, and a dry aseptic dressing being applied in the interval, the cavity gradually granulates up, the superficial wounds heal, and all that remain are several tiny cicatrices.

*Whitlow.*—Cases of whitlow can be treated either with the rubber band or by special suction-glasses, made to fit the finger or hand. The latter line of treatment is perhaps the better, the former is, however, much easier to carry out, and requires no special appliance. The commencing whitlow, which is associated with severe local pain, but little constitutional reaction, can be confidently treated by Bier's method alone. A constricting band is applied in the usual way to the lower part of the upper arm. The arm is carried in a sling, and, if necessary, a dressing is loosely applied to the poisoned finger. In certain cases it will be found advisable to supplement this treatment by prescribing an aperient medicine. The immediate effect of the application of the bandage is to lead to a marked diminution of the pain felt. In some cases the patient will say that it entirely disappears. When he returns for treatment at the end of twelve hours, the limb is seen to be distinctly swollen, the local reaction is much more pronounced, and already there may be indications that an incision to allow of the evacuation of pus is required. When such is the case, all that is necessary will be a tiny puncture with a tenotomy knife. Where the infection is more widespread, and the condition more severe, such as in a case of suppurative teno-synovitis, multiple punctures into the tendon sheath should be made, and through these the sheath douched out with sterilised saline solution. It is not advisable that drainage-tubes be introduced, as these are liable to induce necrosis by pressure on the tendon sheath. A sterile dressing is applied, and the rubber bandage is not reapplied for several hours, to allow of any slight hæmorrhage which the incision may have caused to become arrested. The bandage is worn for twenty to twenty-two hours out of the twenty-four, and twice daily at least the wounds are douched out with saline solution. By carrying out this line of treatment, it will be found that healing will take place earlier, and movements to prevent the formation of adhesions may be practised sooner than in the older line of treatment.

*Mastitis.*—Bier's treatment has been found particularly suitable in



cases of acute mastitis; especially in puerperal mastitis has it been found to be of benefit. The treatment is carried out by means of the suction-cup; the advantages that this line of treatment possess are that in some cases a cure is obtained without resort to the use of the knife. When it is necessary to make an incision, a much smaller one can be used, and it is not necessary to introduce the finger to break down the septa to anything like the same extent as was formerly practised. In addition to the more speedy cure that is obtained as a result of the hyperæmia induced by the suction-glass, there is still another great advantage which its use possesses in the case of puerperal mastitis, and that is that the negative pressure within the glass exhausts the breast of milk, and thus relieves the pain and discomfort which the patient feels, and at the same time permits of the child being nursed from the other breast.

In carrying out Bier's treatment in cases of mastitis, the general rules followed are similar to those already described in connection with the use of the suction-cup. It is advisable that a series of large bell jars be available, so that one can be chosen which accurately and comfortably fits the contour of the breast to be treated. The rim of the glass having been anointed with sterilised vaseline, it is applied to the breast, and a negative pressure is produced within the chamber by slowly rarefying the air by means of an exhaust-pump. Suction must be slowly produced; it must never cause pain, and never be so severe as to produce any subcutaneous ecchymosis. Intermittent applications, over a period of three-quarters of an hour or so, are practised. Where a definite abscess is formed, this is to be treated by incision. It will be found that a local anæsthetic is all that is required in this case. No drainage-tube need be introduced, as the suction-glass will be found to lead to a free discharge of any retained pus. In some cases it is seen that, after the original focus of infection is healed, another forms at the periphery of it. When this is the case, the line of treatment is similar to that already described.

*Arthritis.*—Many infective lesions of joints may be treated by passive or active hyperæmia. Gonorrhœal arthritis is especially suitable for Bier's treatment. In the acute variety, it will be found that the induction of passive congestion by using Bier's bandage is often attended with astonishing relief of pain, and a marked improvement in the patient's health. When combined with treatment of the local lesion from which the organism has passed into the blood-stream, a speedy cure is often obtained. In a case which has passed from the acute stage into a more chronic phase, it will be found advisable to substitute active arterial hyperæmia by hot air for passive congestion. How this is carried out has already been described. It has the advantage that it permits the absorption of the exudate that persists within the joint cavity. It allows of movements of the joint being practised to prevent the formation of adhesions and development of a stiff joint.

*Chronic Arthritis.*—*Tuberculous Synovitis.*—Tuberculous synovitis and tuberculous arthritis can well be treated by passive congestion. Passive congestion was practised in the treatment of tuberculous lesions long before it was used in cases of more acute infections. The method that is now more generally adopted is where the rubber bandage is used to induce hyperæmia. In the early stage of chronic tuberculous synovitis, with thickening of the synovial membrane, and the commencing "gelatinous" degeneration of the joint, the treatment is found to be of especial value. It has the advantage over arthrectomy or erosion that in many cases a cure will be obtained with comparatively little stiffness



of the joint. It must, however, be borne in mind that the progress will be slow and tedious. It is a treatment that must extend over several months, if it is to be attended with beneficial effect. It can, however, be practised by one who is still capable of partial employment; as all that is necessary is that the bandage be applied for one hour night and morning. In the severer cases it is advisable that local rest of the joint be obtained by the use of a splint.

These are a few of the lesions which are particularly suitable for treatment by Bier's method. It will, however, be obvious that the principle underlying the treatment is such as to render it capable of application to an infective lesion, wherever that may be situated. The only difficulty that presents itself is the technical one of applying the treatment in certain situations of the body. In virtually all of these cases, however, this can be overcome by using specially devised apparatus.

**Blackwater Fever.**—Four main theories have been held as to the nature of blackwater fever:—(1) It is a pernicious form of malaria. (2) It is a genuine intoxication. (3) It is a distinct disease due to some specific organism. (4) It is due to a specific hæmolysin. In a recently published memoir, Christophers and Bentley record an elaborate series of observations on this disease, which go in the direction of demonstrating that it is caused by an auto-hæmolysin—that is, a hæmolysin developed by the tissues of the patient by auto-immunisation against his own red cells. Bentley and Christophers believe that they are justified in denying that the disease is due to any ordinary blood parasite, in particular that it is a piroplasmosis. The most thorough and prolonged scrutiny of blood films failed to show any specific organism. They find evidence of its relation to malaria in (1) the greater incidence of malarial infection among blackwater fever patients than among the rest of the community, and (2) in the fact that during the progress of blackwater fever signs of malaria—*i.e.* the presence of the plasmodium in the blood—disappear. It is not a specific disease, but a stage in the progress of malarial infection long continued and constantly repeated—though not malaria, it is of malarial origin.

**CLINICAL AND PATHOLOGICAL FEATURES.**—The disease is ushered in with rigors and high temperature; there is hæmoglobinuria, splenic enlargement, epigastric pain, and, later, jaundice. As a rule the hæmoglobinuria lasts two or three days; relapses, within one to ten days, are common, especially in the more severe cases.

**BLOOD CHANGES.**—The blood corpuscles fall rapidly to as low as a million in bad cases. During the early stages of the disease there are not many changes in the red cells apart from the diminution in their number; “shadows” are met with in stained films, and also small globular corpuscles—“spherocytes.” The large mononuclears are relatively increased. In the later stages—from the second or third day onwards into convalescence—polychromasia is well marked and nucleated reds are found. Macrophages appear in the blood; these are of three types—(1) resembling the ordinary large mononuclears but varying from 15 to 25  $\mu$  in diameter; (2) large, irregularly circular cells with compact nuclei; (3) large cells with irregular nuclei measuring 20-30  $\mu$ . The ordinary granular series of leucocytes are immature, and some myelocytes can be found. The interpretation of the blood changes by



the observers is—first, a rapid blood destruction; second, evidence of phagocytosis of reds; third, regenerative appearances (polychromasia, erythroblasts, immature leucocytes).

**EXPERIMENTAL HÆMOLYSIS IN ANIMALS.**—After injections of hæmolytic serums into dogs, changes were found in the internal organs comparable to what are met with in blackwater fever. Christophers and Bentley found, as had previously been shown by Levaditi, that the principal cause of anæmia in animals so treated was an intense phagocytosis of the red cells in the spleen. Hæmoglobinaemia was not necessarily associated with this, but when it did occur hæmoglobinuria also took place. Hæmoglobinaemia and hæmoglobinuria are therefore concomitant phenomena, the latter necessarily following the former. The important point is that hæmoglobinaemia (without which there is no hæmoglobinuria) does not necessarily result from the most intense blood destruction, but must depend on some further factor. Therefore they distinguish two forms of blood destruction—(1) Erythrokatalysis, or phagocytosis of red cells without extra-cellular solution, and (2) lysæmia, or extra-cellular solution, hæmoglobinaemia, and hæmoglobinuria.

In seeking for a cause of lysæmia Bentley and Christophers investigated the isotonic point of the cells, and could find no evidence that the solution of the corpuscles was due to variations in the osmotic relations of these and the plasma. They believe that what happens is this: In malaria, particularly in the malignant tertian forms, there is recurrent blood destruction, with constant phagocytosis of red cells. As a result of this constant phagocytosis the tissues form hæmolysins. Periodical attacks of hæmoglobinuria are due “to sudden liberation of complement in the living body.” The third part of the theory at present rests on no actual data. Acting on the assumption that blackwater fever is due to an auto-hæmolysin produced in the tissues in response to long-continued blood destruction of malarial origin, Christophers and Bentley have pushed quinine systematically, and thereby reduced the amount of blackwater in the Duars. They suggest that it may prove feasible to produce an anti-hæmolytic amboceptor, or an anti-complement, as a remedy for the disease. (See also PAROXYSMAL HÆMOGLOBINURIA). Christophers and Bentley, “Blackwater Fever,” *Scientific Memoirs of the Govt. of India* (Simla), 1908.

### Bladder, Female.

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MANY of the advances which have been made during the past quinquennium in the diagnosis and treatment of diseases of the bladder in the female apply also to maladies of the bladder in the male; they may be consulted under other headings (*vide* Index). But it will be well to gather together here (in a separate article) some of the most noteworthy of them, and especially those which have a special bearing upon gynecology.

**EXAMINATION.**—Before any instrument (sound or catheter) is passed into the bladder, careful cleansing of the external parts, and especially of the meatus urinarius, should be carried out. This may be done by means of a number of cotton-wool pledgets soaked in an antiseptic lotion or



simply sterilised. When the patient is the subject of leucorrhœa, this cleansing must be very thorough, for there is evidence that organisms from the original discharge may find their way into the bladder and set up cystitis (Porter, *Trans. Edin. Obstet. Soc.*, xxxi. p. 92, 1906). The patient is placed in the dorsal or left lateral position, and the *sound* (shorter than that used in the male and less curved), which has been sterilised by boiling, is introduced by sight into the urethra, and the bladder cavity is carefully examined. If the *catheter* be employed, in order to obtain urine for microscopical, chemical, or bacteriological examination, then the following precautions should be taken. A glass catheter, which has been sterilised by boiling and kept ready for use in a sterile solution, is taken; over its distal end is a short sheath of indiarubber tubing which can be easily removed after its introduction; the part so covered is grasped by the operator with his fore and middle fingers (which may be provided with sterile rubber finger-cots, or may wear a three-fingered rubber glove) and passed into the bladder; the rubber sheath is then withdrawn and the urine allowed to flow into the sterile receptacle (the first few drops being rejected). After it has been emptied by the catheter the holding capacity of the bladder may be determined by *hydrostatic dilatation*: normal saline solution, at a temperature of 100° F., is used; it is kept in a graduated glass jar or douche-can; by means of a catheter and tubing it is run into the bladder till it is uncomfortably full; then the level of the fluid in the reservoir is compared with what it was before, and so the quantity which has passed in is estimated. It must not be forgotten that simple *palpation* of the female bladder is very easy, and that it yields much important information; it is best done by the vagino-abdominal touch. *Cystoscopy* was dealt with in a special article in the *Encyclopædia Medica* (Vol. II. p. 414); but the few additional facts to be recorded about this method of bladder-examination may be placed here. There is perhaps a tendency to limit the use of the cystoscope to a greater extent on account of the risk of infecting the bladder, and a contra-indication is found in the presence of acute urethritis, especially when it is of a gonorrhœal nature. Simple cystitis and that following gynecological operations often clear up with the administration of medicines (*e.g.* urotropin) and the free administration of water to drink, and do not require cystoscopy. For the examination, the patient is placed in the semi-prone position, in the elevated dorso-sacral, in the Trendelenburg, or in the genu-pectoral position. Kelly (*vide* Kelly and Noble, *Gynecology*, i. p. 444, 1907) prefers the last-named posture, the patient being on her knees and *chest*, not on her knees and elbows; and certainly one gets the best view of the interior of the bladder thus, only it is necessary to remember its irksomeness, and to shorten as far as possible the time during which the patient is kept in it. A few drops of a 5 per cent. or 10 per cent. solution of cocaine are introduced into the urethra, which is then dilated by conical dilators, but not beyond 16 or 18 millimetres. Then the Kelly speculum (or the Nitze cystoscope if it be preferred) is introduced into the bladder; air then rushes in, ballooning the bladder (Kelly recommends previous ballooning of the rectum and vagina to prevent displacement backward of the bladder at this stage), and light from a head mirror is thrown into the cavity, which is then inspected in its various parts. Residual urine may be removed with Snell's evacuator (or Ashton's modification of it, *vide* Ashton's *Gynecology*, p. 622, 1905), or with small balls of absorbent cotton



introduced with alligator-jaw forceps. Kelly's ureteral searcher (a long delicate sound) may be used to find the openings of the ureters (the left first); the interureteric ridge is a useful landmark in cystoscopy in looking for the orifices of the ureters, and must not be confounded with another fold called by Kelly the vesico-uterine (because it corresponds with the vesico-uterine sulcus outside the bladder), which lies further away from the internal urethral orifice (Kelly and Noble, *op. cit.*, i. p. 448, 1907). Having found the ureters, a flexible silk catheter may be introduced to obtain a specimen of urine from each kidney, or, if a stricture be present, a metal catheter (*e.g.* Kelly's metallic ureteral catheter) may be employed, or flexible hard rubber sounds may be used for sounding the ureters and kidneys. The latter may be wax-tipped when a calculus is suspected to be present, for the rough parts of the stone will then leave marks on the sound. Conducting forceps may be needed for introducing these sounds and catheters. All the instruments should be very carefully sterilised before use, and boiling water or steam is inapplicable in the case of the silk catheters, which have to be treated with corrosive sublimate solution (1 in 1000). In this way *catheterisation of the ureters* can be easily carried out, and the separate urine from each kidney can be got free from bladder contamination (which cannot be done with the Harris urine segregator).

**MALFORMATIONS.**—A curious anomaly of the bladder, the so-called *intraligamentary bladder*, has recently been described. In this condition the viscus is so developed as to distend and separate the two layers of one or both the broad ligaments of the uterus. It was first noted by Ziegenspeck in 1887, who described a case; another instance was reported by Tandler and Halban in 1901 (*Topography of Female Ureter*); and four further cases were given by Natanson and Zinner (*Monatssch. f. Geburtsh. u. Gynäk.*, xxii. p. 615, 1905). It would appear to be a congenital anomaly; it may be unilateral or bilateral; and when it is unilateral the uterus is pushed over to the opposite side, and the relations of the uterine annexa and round ligaments are altered. Clinically, it forms a fluctuating tumour in the pouch of Douglas or in the parametrium. It is of practical importance, for when it is present the ureters are further removed from the vagina than usual, and since the peritoneum reaches deeply down into the pelvis in front of the bladder, the suprapubic operation can be no longer performed without opening into the peritoneal cavity. Fothergill recently operated on a patient for obscure vesical troubles; on opening the abdomen and distending the bladder, it was seen that there was no utero-vesical pouch and that the bladder reached the upper limits of the broad ligaments in the middle line and extended into them on each side; the peritoneum was incised and the bladder separated from the uterus down to the level of the os internum, and as a result of the operation the patient's condition was considerably improved, and she was able to retain several ounces of urine (*Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 444, 1907). T. Arthur Helme (*ibid.*, p. 447) has recorded one case in which abdominal hysterectomy for carcinoma of the cervix uteri was made very difficult by reason of the presence of an intraligamentary bladder, and a second instance of this anomaly, in which the intraligamentary bladder formed a cystic swelling in the pouch of Douglas, which protruded from the vulva. Doubtless other instances of this vesical malformation will be reported as its existence comes to be better known.



*Ectopia vesicæ*, extroversion of the bladder, or vesical inversion, one of the most trying malformations which a woman has to bear, has continued to engage the attention of the surgeon. Maydl led the way in recent years in the new direction of throwing the urine into the rectum so as to control the urinary incontinence, which is the leading and the most disagreeable symptom caused by the anomaly. He transplanted the entire trigone of the bladder into the rectum or sigmoid flexure. The Maydl method was an intra-peritoneal operation, and had a considerable mortality (about 33 per cent.). Moynihan's procedure (*Ann. Surg.*, xliii. p. 237, 1906) marked an advance, for it was carried out extra-peritoneally: he catheterised the ureters and excised the entire bladder wall; he then pushed the recto-vesical peritoneum up off the anterior aspect of the rectum, which he incised; and he finally inverted the bladder and implanted it into the rectal wall. Moynihan's method, however, is not applicable to the female. Hunner (Kelly and Noble, *Gynecology*, i. p. 465, 1907) regards Peters's operation as the best: in it there is an extra-peritoneal transplantation of each ureter (with enough of the bladder wall to preserve the uretero-vesical musculature) into the corresponding side of the rectum; the ureters are first catheterised, they are then dissected out with the piece of bladder wall to which they are attached, and they are then transplanted into the rectum just above the internal sphincter (*Brit. Med. Journ.*, for 22nd June 1901). London, Newland, and Bond (*Brit. Med. Journ.*, i. for 1906, pp. 961, 964, 1151), as well as Sherman (*Journ. Amer. Med. Assoc.*, xlv. p. 890, 1905), have used this method, with a 20 per cent. mortality, but with good permanent results in the surviving patients; it is quite extra-peritoneal, it preserves the musculature, and it is said to be easier than the other plans. One of the aggravations of *ectopia vesicæ* is the possibility of the development of cancer in the malformed organ, an instance of which has been reported by Keitler (*Monatssch. f. Geburtsh. u. Gynäk.*, xxii. p. 186, 1905).

DISPLACEMENTS.—It has been found necessary to distinguish between the various conditions in which the bladder or a part of it or of the urethra is displaced downwards and appears at the meatus urinarius. The displaced mass may consist of the bladder (urethral cystocele; hernia, inversion, or prolapse of the bladder); then the two ureteral orifices will be seen on it. In other cases it is simply the mucous membrane, loosened from the other layers of bladder wall, which projects; it is softer and smaller than in the former variety. In yet other instances, the mucous membrane of the urethra itself is the displaced part, and then a depressed orifice in the centre of the mass can be recognised (Villar, *Arch. prov. de chir.*, xiv. p. 373, 1905). A case has been reported in which a cystic ureter was displaced downwards and protruded from the urethra; it formed a mass the size of a hen's egg; the patient was a female infant of six weeks; the mass was removed, but the child died, and it was at the autopsy that the condition of affairs was discovered (E. von Hibler, *Wien. klin. Wochensh.*, xvi. p. 506, 1903).

CYSTITIS.—It is now generally accepted that inflammation of the bladder is practically always due to microbic invasion of the tissues, and that the other so-called causes (*e.g.* foreign bodies, such as hairpins, stone, tumours, abnormal urine, operative or non-operative trauma, displacements, and "chills") are only predisposing; it is also believed that the causal organisms in their order of frequency are the colon bacillus,



the gonococcus, the streptococcus and staphylococcus pyogenes, the proteus vulgaris, and the tubercle and typhoid bacillus. But whilst this is so, these predisposing and exciting causes are generally linked together: most of the microbes may be present in the urine without infecting the bladder wall if the vesical tissues be not predisposed to their action by one or more of the above-named causes; and even when the non-microbial cause (*e.g.* trauma or chill) is very obviously present, it may not result in cystitis in the absence of infecting organisms. At the same time it is believed that the gonococcus and the tubercle bacillus may infect a healthy bladder; mixed infection (*e.g.* with the gonococcus and the colon bacillus) may also occur. In gynecology, it has always to be borne in mind that certain of the predisposing causes are more prominent than in ordinary surgery: for instance, the urethra is short, and there is evidence that foreign bodies are not infrequently introduced, carrying with them the risks of injury and infection (this may happen in connection with attempted abortion, with catheterisation, or with manœuvres carried out to excite erotic feelings); again, the proximity of the bladder to the uterus and annexa will subject it to the risks accompanying morbid states of these organs (*e.g.* microbial infections, parametritis, ovarian abscess, rupture of dermoid cysts, incidents connected with ectopic gestation, formation of vesico-vaginal or vesico-uterine fistulæ as results of dystocia, etc.). These matters must all be kept in mind in dealing with cystitis in the female; and the frequency with which hysterectomy (abdominal and vaginal) and hysteropexy or ventrofixation of the uterus are now performed must not be forgotten, for these procedures bring the bladder immediately into the sphere, and subject it to the risks of operative manipulations. The freedom with which cystoscopy is employed for diagnostic purposes, and the use of catheterisation of the ureters, etc., introduce additional risks of bladder-infection. Fortunately, these dangers of post-operative cystitis can be largely avoided by strict asepsis and by gentleness during operation, and by the rigid application of the rules of surgical cleanliness in the performance of catheterisation afterwards. The treatment of cystitis in the female is facilitated by the topographical relations of the organ; it is also modified to some extent thereby. The diagnosis must first be made by the discovery of pus in the urine; the possibility of renal or ureteric disease is in a number of instances to be excluded by cystoscopy; and the particular variety of microbe which is present is to be settled by bacteriological examination of the urine. It may be noted here that Hunner (*Amer. Med.*, vii. pp. 701-707, 1904) believes that the demonstration of the tubercle bacillus in urine can be made with comparative certainty. There have been of late years marked advances in the treatment of cystitis, and these are particularly applicable to the disease as it occurs in women. With them has come the power of differentiating various morbid states and of settling upon the special method to be used in any given case. For instance, the diagnosis of the kidney as the seat of mischief will prevent the medical man wasting valuable time in the treatment, useless under the circumstances, of the bladder. To prevent cystitis means must be taken to diminish the frequency of catheterisation, especially during and after labour and operations; for this purpose free drinking of water should be inculcated, and all other plans to aid micturition should be employed (*e.g.* injection of hot water into the rectum) before recourse is had to the catheter. Amongst the more useful medicines



which may be given in cystitis, urotropin (in doses of 10 grs. thrice daily) and helmitol (also a hexamethylenetetramine preparation) and salol may be named. For local treatment, antiseptic irrigations, instillations, and topical applications have been found of great value; one may begin with irrigations of normal saline solution till the bladder is able to tolerate antiseptic solutions such as that of silver nitrate (from 1 in 5000 to 1 in 500) or of bichloride of mercury (from 1 in 150,000 to 1 in 5000). Instillations enable us to use stronger solutions at less frequent intervals (*e.g.* once or twice a week); for instance, the instillation of one ounce of protargol solution (1 to 3 per cent.) in this way is of great value. Topical applications carried out with the patient in the genu-pectoral position, with the bladder distended with air, and through a tubular speculum, enable us to attack the mucous membrane alone and to concentrate upon the specially diseased spots in it (Hunner in Kelly and Noble's *Gynecology*, i. p. 483, 1907). In this way nitrate of silver solutions give good results in ulcers of the bladder. Among the directly surgical means now employed, curettage can hardly be said to be free from risk, and is not so much used, its place being taken to a large extent (in intractable cases) by the artificial formation of a vesico-vaginal fistula well in front of the cervix in the anterior vaginal fornix (vaginal cystotomy); the bladder is to be distended first, and the operation carried out with the patient in the knee-chest position, the incision being made from the vaginal aspect with the aid of sight. The inconvenience resulting from the urinary incontinence, which necessarily accompanies this procedure, may be obviated, as Hunner (*op. cit.*) suggests, by the tub-bath with constant bladder irrigation. In very severe cases excision of the diseased mucous membrane may be required.

Among recent contributions to the literature of cystitis in the female the following articles may be named:—

1. In 1904: HARRISON, *Amer. Journ. Obstet.*, xlix. p. 95, 1904; BAISCH, *Zentralb. f. Gynäk.*, xxviii. p. 380, 1904; *Beitr. z. Geburtsh. u. Gynæk.*, viii. p. 297, 1904; HIBBITT, *Amer. Practitioner and News*, xxxvii. p. 97, 1904; SPANTON, *Brit. Gynec. Journ.*, xx. p. 14, 1904-5; ROSENSTEIN, *Zentralb. f. Gynäk.*, xxviii. p. 865, 1904; TATE, *Amer. Journ. Obstet.*, l. p. 641, 1904.—2. In 1905: STOECKEL, *Berl. klin. Wochensch.*, xlii. p. 20, 1905; LUYS, *Rev. prat. d. mal. d. org. gen.-urin.*, ii. p. 26, 1905; KNORR, *Zeitsch. f. Geburtsh. u. Gynäk.*, lv. p. 472, 1905.—3. In 1906: GERSUNY, *Zentralb. f. Gynäk.*, xxx. p. 105, 1906; KELLY, *Canad. Pract. and Rev.*, xxxi. p. 61, 1906; TAUSSIG, *Surg. Gynec. and Obstet.*, ii. p. 181, 1906; HEYMANN, *Centralb. f. d. Krankh. d. Harn- u. Sex-Org.*, xvii. p. 177, 1906; RICHTER, *Zentralb. f. Gynäk.*, xxx. p. 483, 1906; WITTHAUER, *ibid.*, p. 663, 1906; TAUSSIG, *Amer. Journ. Obstet.*, liv. p. 465, 1906.—4. In 1907: DIXON, *Amer. Journ. Dermat. and Gen.-Urin. Dis.*, xi. p. 12, 1907; ELY, *Amer. Journ. Obstet.*, lvi. p. 371, 1907; GARCEAU, *ibid.*, p. 289, 1907; PICHEVIN, *Sem. gynéc.*, xii. p. 401, 1907.—5. In 1908: M'DONALD, *Med. Rec.* (New York), lxxiii. p. 303, 1908; FROMME, *München. med. Wochensch.*, lv. p. 873, 1908; PADGETT, *Journ. Indiana Med. Assoc.*, i. p. 453, 1908.

Blood.

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ORIGIN AND RELATIONSHIPS OF THE BLOOD CORPUSCLES.—Notwithstanding much investigation from all sides, the origin and relationships



of the blood corpuscles are still very obscure. Since, however, the subject has more scientific interest than practical bearing on clinical medicine, a short general account of the present position of affairs will suffice.

*Red Corpuscles.*—The non-nucleated red corpuscle of the blood is certainly derived from the nucleated erythroblast of the bone marrow. Hayem's theory, that the blood plates (hæmatoblasts) are the precursors of the red corpuscles has been altogether discarded. In extra-uterine life, then, the red corpuscles must be regarded as arising solely from nucleated cells in the bone marrow. These cells lose their nuclei either by a process of extrusion (Muir and others), or breaking down in the cell (Pappenheim). The earlier stages in the development of the red corpuscle are much less certain, the main question at issue being whether it has an ancestral cell in common with the leucocyte, or whether there are distinct and separate primitive red and white cells. On the whole, most authorities (Pappenheim, Wolff, and others) incline to the former alternative, and trace all the blood cells to a primitive undifferentiated cell, resembling a lymphocyte. The immediate precursor of the normal erythroblast of the marrow (normoblast) is the megakaryoblast.

In disease the process of blood-formation may revert to the embryonic type. This is evidenced by (1) the appearance of megakaryoblasts in the blood, (2) the extension of the blood-forming marrow beyond its normal limits, and (3) the reversion of the spleen and liver to their embryonic hæmopoietic function (myeloid transformation).

*White Corpuscles.*—As regards the leucocytes, also, there are two different theories. Ehrlich holds that there are two distinct varieties of these cells, the lymphocytes, and the cells of the bone marrow. These cells differ from one another—(1) in their source, the former arising from lymphatic tissue, the latter from bone marrow; (2) morphologically, the former having a round nucleus, no granules, a cytoplasm more basophile than the nucleus, while the latter have more or less irregular nuclei, and contain neutrophile, eosinophile, or basophile granules. To the marrow cells we must also add the non-granular mononuclear, which differs from the lymphocyte in having a cytoplasm less strongly basophile than the nucleus. (3) The lymphocytes are destitute of the power of amoeboid movement; the marrow cells have the power of amoeboid movement, and are thus able to emigrate from the vessels. According to this theory the marrow cells and lymphocytes are genetically distinct—they have no common ancestor. Leucocytosis is essentially different from lymphocytosis; the former is an active emigration of marrow cells caused by chemotactic influence, the latter is a passive flooding of the blood with lymphocytes washed out of the lymphoid tissues.

The alternative hypothesis to that of Ehrlich is that all the leucocytes are derived from a primitive undifferentiated cell (leucoblast), and is the one at present most generally adopted (Uskow, Gulland, Grawitz, Michaelis, Pappenheim). The supporters of the monist theory, however, are in no wise agreed upon the nature of the primitive cell. According to Uskow it is a small lymphocyte; to Pappenheim a large lymphocyte; to Wolff an undifferentiated lymphoid cell, apparently resembling the "large mononuclear." The genealogy ascribed to the different forms of leucocyte naturally differs according to which of these is regarded as the true primitive cell. Ehrlich's propositions have been attacked on the grounds that—(1) granules ("azurophil") can be demonstrated in lymphocytes (Michaelis); (2) lymphocytes show amoeboid movement



(Hirschfeld); (3) the lymphocytosis of early tuberculous serous effusions is active, not passive. Finally, a number of anomalous cases of leukæmia have now been described which do not exactly fit into either of the two main categories of the disease, but in which both lymphocytes, myelocytes, and unclassifiable intermediate forms are in excess.

**BLOOD IN INFANCY AND CHILDHOOD.**—The average number of red corpuscles at birth is  $5\frac{1}{2}$  millions, but they decrease rapidly during the first week, reaching the adult number of 5 millions by the seventh or eighth day. At birth the percentage of hæmoglobin is 110; this also falls steadily until by the sixth month it is no more than 70. It does not begin to rise again until the end of the second year. In the newly-born infant the leucocytes number 20,000 per c.mm. During the first week there is a somewhat rapid fall, followed by a slow rise, which continues during the first six months, by which time they average 15,000. After this time a still more gradual diminution occurs, but the adult figure is not reached until the fifth or sixth year. The birth leucocytosis is due to excess of polynuclears, whereas the leucocytosis of infancy is due to excess of lymphocytes, and is probably neither more nor less than a manifestation of the activity of the lymphoid tissues, which is a feature of this period of life. Within a day or two of birth a few nucleated reds may be found in the peripheral blood; at a later date their appearance must be regarded as pathological.

*Pathological Changes.*—In interpreting the changes in the blood in anæmia and other diseases of infancy, the following points should be borne in mind:—(1) Reversion to the foetal type of blood-formation takes place under very slight provocation. Normoblasts, megaloblasts, and myelocytes may appear in any form of anæmia, and have not the same grave significance as in later life. (2) Leucocytosis is common in all forms of anæmia. (3) Owing to the activity of the lymphoid tissues, lymphocytosis is of frequent occurrence. (4) The colour index is always low.

**CLINICAL EXAMINATION OF THE BLOOD.**—1. *Estimation of Hæmoglobin.*—*Haldane's Hæmoglobinometer.*—This is a modification of Gower's instrument in which the error arising from the use of an inconstant artificial colour standard is obviated. The standard devised by Haldane consists of a hermetically sealed tube containing a dilute solution of blood of known oxygen capacity saturated with coal gas. The solution is permanent, and the colour does not deteriorate. The instrument is used in the same way as Gower's hæmoglobinometer, except that before a reading is taken the graduated tube containing the patient's blood is filled with coal gas and closed with the finger. The liquid is then made to run up and down the tube so that the hæmoglobin is saturated with CO, and shows the characteristic pink tint. The percentage is read off in the ordinary way; the error need not exceed 1 per cent., and where great accuracy is required the mean of several readings is taken. As the pigment in both tubes is the same, a standard light is unnecessary.

*Tallquist's Scale* provides a simple, though somewhat rough means of estimating the hæmoglobin. It consists of a lithographed scale of tints and a book of filter papers. A drop of blood is allowed to soak into a piece of filter paper, and the colour of the spot compared with the scale. The limit of error does not exceed 10 per cent.

2. *Glycogen Reaction.*—*Technique.*—The solution employed, which serves for fixing, staining, and mounting, is composed of iodine, 1 gram;



iodide of potash, 3 grams; distilled water, 100 c.c., with enough gum arabic to give a syrupy consistence. A drop of this is placed on a slide, and covered with an ordinary air-dried smear preparation of the blood to be examined. After half a minute the superfluous iodine solution is absorbed with filter paper, when the specimen is ready for examination under an oil-immersion lens. Daylight, or incandescent gas is the best illuminant; a yellow flame is very unsatisfactory. Normally the red corpuscles stain brightish yellow, the leucocytes pale yellow. A certain amount of extra-cellular glycogen is seen in the form of brown or red granules, but under normal circumstances the leucocytes show no trace of it. The amount of this extra-cellular glycogen varies a good deal, and no significance can be attached to it.

These appearances are regarded as a "negative glycogen reaction." In the "positive reaction" the polynuclear leucocytes show red or brown glycogen either (1) as a diffuse coloration, (2) as a few granules scattered through the cell, or (3) as coarse granules, most abundant at the periphery of the cell body or projecting like pseudopodia from it. The number of cells so affected varies between 2 or 3 per cent. and 9 per cent., and the degree of the reaction is proportionate to the severity of the cause. A positive reaction occurs—(1) in severe disturbance of respiration, (2) in anæmia, (3) in toxæmias of metabolic origin, (4) in suppuration and bacterial infections. The chief importance of the reaction is in the diagnosis of the last series of diseases. Croupous pneumonia, empyema, abscess and gangrene of the lung, sepsis of all kinds, acute appendicitis and peritonitis all give a marked positive reaction. On the whole, then, the reaction occurs in the same class of case as does polynuclear leucocytosis, but it is a less ambiguous sign than the latter. Leucocytosis occurs in conditions in which the glycogen reaction is negative, and conversely in severe septic infections and pneumonia there may be no leucocytosis, while the glycogen reaction is very intense. Locke insists that a well-marked glycogen reaction occurs only in patients who are really seriously ill, hence its detection in a case which does not admit of a positive diagnosis should always put the observer on his guard.

**EXAMINATION OF STAINED FILMS.**—The blood stains at present in use for clinical purposes are Ehrlich's triacid stain, Leishman's stain, and Jenner's stain. Of these the last is the most generally useful. Ehrlich's triacid stain is a mixture of fuchsin, orange G., and methyl green; Leishman's and Jenner's stains are eosin-methylene blue dyes, in which the latter has the polychromatic properties of Romanowsky's stain. The preparation of these stains is difficult, and it is best to procure them ready made either in solution or tablet form.

*Method.*—*Triacid Stain.*—Grübler's triacid should be used. Films are made in the usual way (*Encyclopædia Medica*, Vol. I. p. 532) and fixed by heat, either in an oven or an oblong copper plate (2 ins. by 10 ins.), one end of which is heated by a Bunsen flame. Where an oven is used, the films are slowly raised to a temperature of 160° C., and then allowed to cool gradually. When the second method is employed, water is dropped on the plate at the end farthest from the flame until a spot is found at which it boils. Instead of water, xylol, which boils at 137° C., or toluol, which boils at 110° C., may be used. On one of these spots the films are placed face downwards for a period varying from five minutes at 160° to half an hour at 100°. The important point in heat fixation is to employ a sufficiently high temperature; bad differentiation is



generally due to underheating. The best results with triacid are got by heat fixation, but, as Gulland has pointed out, it is not absolutely essential for very fair pictures can be got by fixing the air-dried film for three minutes in 10 per cent. formalin alcohol. It is then washed and stained. The triacid solution should in either case be allowed to act for three minutes. In good preparations the red cells are orange, the neutrophile granules are violet-brown, the eosinophile granules violet-red, the nuclei green; basophile granules do not stain. The nuclei react with varying degrees of affinity to this stain: those of erythroblasts are deep greenish-blue, with well-defined outlines; those of polynuclears are scarcely so intense; while the lymphocytes and large mononuclears are often very faintly tinged. In underfixed films the red cells are reddish-brown, in overfixed films they are pale lemon-yellow.

*Jenner's Stain.*—The solvent of this stain, methyl alcohol, also fixes the films, so that the two processes of dyeing and fixing are carried out simultaneously. When this, or Leishman's stain, is used in the form of tablets, chemically pure methyl alcohol (Merck) must be used. A few drops of the stain are allowed to fall on the air-dried film, which may be covered to prevent evaporation. The dye is allowed to act for from one to five minutes; the film is rapidly washed in distilled water, and allowed to dry in the air. It must not be heated. Gulland advises staining for a shorter time ( $\frac{1}{2}$  to  $1\frac{1}{2}$  mins.); if one wishes the methylene blue to predominate, one should stain for a shorter time; if the eosin, for a longer time. Bad results are usually due to too prolonged staining. In successful preparations the red corpuscles are rose-red, nuclei blue, eosinophile granules ruby, neutrophile granules pink, basophile granules deep violet-blue, malaria parasites and bacteria blue. The weak point about the stain is that it does not always differentiate the neutrophile granules satisfactorily.

*Leishman's Stain.*—Enough stain is dropped on the unfixed air-dried smear to cover the whole cover-glass. This is allowed to act undiluted for half a minute (to fix the film) and then distilled water is added drop by drop until a translucent scum appears on the surface. About twice as much water as stain is required. The dilute dye is allowed to act for five minutes, and then washed off with distilled water. In Leishman-stained specimens the nuclei are a red-violet, eosinophile granules pink, neutrophile granules red, red cells pink or greenish, malaria parasites pale blue, with carmine-stained nuclei. Leishman's stain often fails to differentiate the neutrophile granules satisfactorily.

*Comparison of these Stains.*—They together give the maximum of clinical information, and it is unnecessary to supplement them by others in ordinary work. Jenner's is, on the whole, the most useful, and in good preparations gives all the necessary information. Unfortunately, however, the neutrophile granules are not always well brought out, and when this is the case it is impossible to distinguish between large lymphocytes and neutrophile myelocytes. For this reason it is often advisable to control it with a specimen stained by the triacid stain, which excels in differentiating neutrophile granules, though it is not so good for lymphocytes. Leishman's stain is less useful in ordinary blood examinations, but is the best for protozoa—*e.g.* malarial parasites and trypanosomes. For cyto-diagnosis of serous fluids Jenner's stain is perhaps the best. The triacid mixture is useless, as it does not stain bacteria.

*Wright's Stain*, a modification of Leishman's, is strongly recom-



mended by Gulland for the azurophil granulations of lymphocytes, as follows:—Drop a smear before it is dry into a weak solution of the stain in methyl alcohol; leave it to stain for any time up to half an hour, dry, and mount in balsam.

*Examination of Stained Films.*—For accurate work a  $\frac{1}{12}$  in. oil-immersion lens and a mechanical stage are almost necessities. With practice it is possible to differentiate cells with a lower ( $\frac{1}{8}$  in.) power, but their appearances must first have been learned with the aid of the immersion lens. Systematic differential counts can scarcely be made without a mechanical stage, and the examination of successive fields by moving the slide with the fingers is a very laborious process.

**DIFFERENTIAL COUNTING.**—This consists in enumerating the varieties of leucocytes seen in successive fields until 500 have been counted. The numbers of the different cells are jotted down on a piece of paper as they are counted. It is customary to differentiate small lymphocytes, large lymphocytes and mononuclears, polynuclears, eosinophiles, mast cells, and myelocytes, and at the same time to note any abnormal red cells seen, as normoblasts, megaloblasts, fragmentation of nuclei, basophilia, mitoses, etc. In differential counting the chief difficulty arises in connection with the “large lymphocyte,” for, on the one hand, we have to draw a distinction between a typical large lymphocyte with strongly basophile protoplasm and a small lymphocyte, and, on the other, between a large lymphocyte and a large mononuclear with a pale cytoplasm and darker nucleus. The distinction is often dependent on the personal equation of the observer, and some prefer to class as “lymphocytes” both the small and large forms with basophile cytoplasm, and as “large mononuclear and transitional cells” those with pale cytoplasm and darker rounded or irregular nuclei.

Differential counts may be stated as percentages, or converted into absolute numbers of cells per cubic millimetre. The latter is better, as by it we can distinguish between relative and absolute variations in the different cells. The following table shows in round numbers the percentages and totals of the leucocytes in the normal adult, taking the total leucocytes as 8000 per c.mm.:—

	Per Cent.	Total.
Small lymphocytes . . . . .	20-30	1600-2400
Large do. (incl. “transitionals”)	4-8	320-640
Polynuclears . . . . .	60-75	4800-6000
Eosinophiles . . . . .	5-5	40-400
Basophiles . . . . .	5	40

The advantage of stating the absolute numbers of cells is obvious from such an example as the following:—

	Percentage.	Total Leucocyte Count. A=4000 p. c.mm.	Total Leucocyte Count. B=20,000 p. c.mm.
Small lymphocytes	70	2800	14,400
Large do.	5	200	1,000
Polynuclears . .	24	960	4,800
Eosinophiles . .	5	20	100
Basophiles . .	5	20	100

From the percentage alone we can only infer that there is a relative lymphocytosis. Stated as totals, however, it is obvious that in case A the lymphocytes are normal and the polynuclears diminished (inactivity of the bone marrow), while in B the polynuclears are normal and the



lymphocytes increased (excessive activity of the lymphoid tissues, possibly leukæmia).

*Special Examination of the Polynuclear Neutrophiles.*—Arneth has studied the neutrophile cells from a fresh standpoint. He arranges them severally in groups according to the shape of the nucleus—I. mononuclear, II. bilobed nuclei, III. trilobed nuclei, and so on. He adopts Pappenheim's view that increasing polymorphism of the nucleus is a sign of progressive ripening of the cell, and on this assumption it is natural to suppose that in health some fairly constant ratio must exist between the numbers of the different stages present. Arneth states that the normal percentage is as follows:—I. 5 per cent., II. 35 per cent., III. 31 per cent., IV. 17 per cent., V. and over, 2 per cent. In disease, especially infectious disease, the neutrophile picture is altered, so that a larger number of the cells appear in groups I. and II., and Arneth and some of his followers ascribe considerable diagnostic and prognostic importance to this "pushing the neutrophile picture to the left." It must be said, however, that not all observers accept Arneth's figures as normal averages; some think that the number of young forms in health is higher than his estimate.

PATHOLOGICAL APPEARANCES (see *Encyclopædia Medica*, Vol. I. pp. 522-525).

*Leucocytes.*—1. *Mast Cells.*—The basophile cell which is normally found in small numbers in the blood has a convoluted nucleus and fine granulation. Mast cells differ from these in possessing round, faintly-staining nuclei, and coarse granules. They vary much in size (8 to 20  $\mu$ ); they occur in leukæmia, in the splenic anæmia of infancy, and occasionally in severe anæmia from other causes. The general meaning of basophilia is unknown.

2. *Neutrophile Pseudo-Myelocyte (Ehrlich).*—This resembles a myelocyte, but is much smaller. It is not uncommon in infantile anæmia, and is probably a dwarfed form.

3. "*Reizungs-form*" (*Türck*).—This is a cell somewhat larger than a small lymphocyte, with a round nucleus, poor in chromatin, and a cytoplasm which stains deep red with the triacid mixture. Its significance is unknown.

*Red Corpuscles.*—1. *Megaloblasts.*—Isolated megaloblasts may occur in any bad case of anæmia, but the only conditions in which they appear in abundance are pernicious anæmia, bothriocephalus anæmia, anæmia from nitro-benzole poisoning, and anæmia in infancy.

2. *Atypical Erythroblasts.*—Under this head we may group cells intermediate between normo- and megaloblasts, cells with multiple nuclei, and cells showing fragmentation of the nucleus.

3. *Basophile Degeneration of Red Corpuscles.*—*Granular Basophilia.*—Basophile red corpuscles show a fine stippling or granulation when stained with basic dyes. The granules may be scanty (two or three only) or scattered throughout the whole cell. Basophile degeneration usually occurs in non-nucleated cells, and is believed to be a product of nuclear disintegration. The condition occurs in pernicious and serious forms of secondary anæmia, but is especially characteristic of chronic lead-poisoning.

THE BACTERIOLOGICAL EXAMINATION OF THE BLOOD can only be satisfactorily carried out by withdrawing blood from a vein. A drop of blood obtained through a puncture of the skin is extremely liable to accidental contamination with skin organisms. *Technique.*—The skin



over a vein in the forearm or on the dorsum of the foot is thoroughly sterilised by washing with lysol, sterile water, and ether. The vein is made turgid by a proximally placed bandage, and the needle of a sterile syringe (*e.g.* an antitoxin syringe) is plunged obliquely into its lumen. Several c.c. of blood should be withdrawn and inoculated in bouillon, on the surface of an agar tube, etc. Cultures from the blood made in this way often give positive results in septicæmia, pneumococcal infection, and other blood infections. It has been shown, for example, that in typhoid fever the organism can be detected in the blood from the very onset of the malady, before it appears in the stools—a fact which proves that the disease is in truth a general blood infection. (See TYPHOID.)

**ALKALINITY OF THE BLOOD.**—Haycraft's method of estimating the alkalinity of the blood (*Encyclopædia Medica*, Vol. I. p. 528) has been superseded by Engel's alkalimeter and Dare's hæmoalkalimeter. In the former a solution of blood is titrated with  $\frac{1}{75}$  normal tartaric acid against litmus; in the latter the amount of  $\frac{1}{2000}$  normal tartaric acid required to neutralise a definite quantity of blood is estimated by the spectroscope, and from the figure so obtained the alkalinity is calculated. Up to the present time clinical alkalimetry has not proved of any real value.

**Cryoscopy.**—This method of examination has not realised the anticipations which were formed of it when first introduced (see CRYOSCOPY, p. 128).

**COAGULATION OF THE BLOOD.**—A great number of methods have been devised from time to time for estimating the coagulability of the blood, but since serious fallacies are introduced in all except Addis's apparatus, a short description of some of the more commonly used is all that is necessary.

*Wright's coagulometer* is perhaps the best known. It consists of a series of uniformly calibrated tubes, into which blood is sucked; these are, when filled, maintained at a fairly constant temperature of 37° C. by means of a small water-bath. The coagulation time is determined by successively blowing the contents of the tubes on to filter-paper and noting when fibrin has formed.

*Sabrazes's method* depends on the fact that when blood coagulates in capillary tubes a fine thread of fibrin can be demonstrated when the tube is broken across. The tubes are intended to be kept at a constant temperature. *M'Gowan's method* is somewhat similar. A tube with a lumen of 1.5 mm., and about 7 in. long, is filled with blood, and portions of the tube are broken off every half-minute until the thread of fibrin is seen.

*Brodie and Russell's Method.*—The apparatus consists of a circular box, which fits on the stage of a microscope. The floor is of glass, and the lid consists of an inverted truncated glass cone, on the tip of which a drop of blood can be picked up. When the glass cone is in position the edges of the drop of blood can be focussed by the microscope. A constant temperature is maintained by a water-jacket, and the blood is kept in circular motion by a stream of air from a small blowpipe, which perforates the lateral wall of the box, impinging against its edge. This coagulometer was improved by Boggs, and greatly modified by Addis, whose apparatus, although complicated, is the only one which gives consistent and comprehensible results.

*Addis's Coagulometer.*—The apparatus consists of Boggs's modification of Brodie and Russell's coagulometer, with a thermometer for reading the temperature in the chamber. Instead of depending on a



current of air to cause a streaming movement of the corpuscles, Addis employs paraffin oil, so that when the coagulometer is in use the blood is completely surrounded by oil, except when it is in contact with the glass cone. The oil is delivered from a large tank, and there are arrangements for maintaining (*a*) an absolutely constant temperature, and (*b*) a constant pressure of outflow. Addis has proved that in all the coagulometers hitherto employed, the provision made for regulating the temperature is very imperfect, and that variations in temperature which previous observers regarded as negligible have a profound effect on the coagulation time—are, indeed, the actual cause of the variations which have been observed, and which have been erroneously ascribed to the administration of drugs, etc. For a full description of the apparatus, and the technique which must be observed in its use, the reader is referred to Addis's paper (*Quarterly Journ. Exper. Physiology*, Nov. 1908).

According to Addis, the following conditions are essential to the accurate determination of the coagulation time of the blood by any method:—1. The blood must be obtained under the same conditions in each experiment. This condition is sufficiently fulfilled by (*a*) taking the first blood which flows after puncture, and (*b*) thoroughly cleansing the skin and all apparatus from previously shed blood and fibrin ferment. 2. All estimations must be at the same temperature; the coagulation time of the blood varies regularly with the temperature. At 3·25° C. it is 63 mins. 20 secs.; as the temperature rises it steadily diminishes, until at 36° it is only 1 min. 25 secs.; thereafter it begins to increase up to the temperature of 51·5°, when it is 5 mins. 15 secs. At higher temperatures coagulation is interfered with. Within the ordinary limits of room temperature great variations occur:—

Temp. C.°	Coag. Time.	
	Mins.	Secs.
10·25	21	30
12·25	16	30
13·5	14	32
15·5	11	46
16·5	10	10
17·5	8	27
18·5	7	34
19·5	6	2
20·5	5	22

3. In each observation the blood must be in contact with the same amount and kind of foreign body. 4. The end point must be clear and definite, and must always indicate the same degree of coagulation. With Addis's apparatus, three possible stages might be taken as indicating coagulation—(1) The earliest appearance of a streak of clot; (2) the stoppage of the main flow of blood and the clear appearance of a laminated clot; (3) complete cessation of flow. The second of these can be most accurately determined.

In health there is practically no variation in the time of coagulation of the blood. The differences which have been observed are entirely explained by variations in temperature. The coagulation time shows no diurnal variation such as has been described by some authors. What is more important, perhaps, is the fact that the administration of calcium salts does not increase, nor the administration of citrates diminish, the coagulability of the blood. The coagulometer described



is inapplicable to a number of pathological conditions, and the results quoted apply to normal individuals. In a number of diseases the corpuscles tend to become agglutinated by their own serum, which hinders their flow, and makes it impossible to determine when coagulation occurs.

ESTIMATION OF THE CALCIUM SALTS OF THE BLOOD.—Blair Bell has devised a method of estimating the calcium of the blood which is applicable to clinical work. Calcium exists in the blood in two forms—a non-dissociable form in combination with the protein molecules, and an ionizable form. Only the ionic calcium (which alone is concerned in coagulation) can be estimated by Bell's calcimeter. The instrument consists of a series of accurately calibrated pipettes. Into one of these 100 c.mm. blood is sucked, and is then thoroughly mixed with 250 c.mm. 1 in 30 aqueous solution of oxalic acid (Merck's chem. pure). After standing for ten minutes there is added 250 c.mm. of a mixture of acetic acid (1 per cent.), 95 parts, and glycerin, 5 parts, to break up the corpuscles, and the mixture is thoroughly shaken. Of this mixture 100 c.mm. is added to 500 c.mm. distilled water, and a drop is placed on a Thoma counting chamber. The crystals of calcium oxalate which have formed are counted in 256 small squares (16 sets of 16). An average of 1 crystal per square = calcium index 1 = 1 part of CaO in 6000 distilled water. The crystals are exceedingly minute, and are often difficult to discern. Artificial light should be used for counting. Considerable practice is required before the observer's results can be depended on. In ordinary adults the normal standard varies from 1 to 4000 to 1 to 5000 CaO in the blood.

Addis investigated the accuracy of this method by comparing the counts in normal animal serum, and animal serum diluted with distilled water, and with solutions of calcium of known strength. He found that the limit of unavoidable error was between 6 and 7 per cent., and as the calcium index fluctuates considerably, this may be regarded as comparatively negligible. Addis further showed that the administration of citric acid rapidly lowered the index (*e.g.* from .92 to .67 in an hour and a half), and that calcium salts as rapidly raised it (*e.g.* from .8 to 2 in the course of twenty-four hours, and from .91 to 1.14 in an hour). As stated in the preceding paragraphs, these changes in the calcium contents of the blood do not influence its coagulation time—indeed, it is probable that the variations in the calcium which follow ordinary doses are too small to affect coagulation under any circumstances.

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**Blood-Pressure.**—BLOOD-PRESSURE, MEASUREMENT OF.—

The instruments employed for estimating the blood-pressure clinically may be divided into two groups—(1) those which compress a single artery; and (2) those which compress the whole circumference of a digit or limb. Of the very many forms of apparatus which have been devised, the following may be mentioned:—

1. *Von Basch's Sphygmomanometer.*—Although this instrument has been superseded, and is now almost obsolete, it deserves mention as one of the earliest which was of practical use. It consisted of a mercurial manometer connected with an air-chamber with an elastic membrane, which was depressed on the radial artery until pulsation in the distal portion of the vessel ceased. The pressure required for this was read on the manometer. Von Basch's sphygmomanometer was subsequently modified more than once, and an aneroid was substituted for a mercurial manometer.

2. *Oliver's Hæmodynamometer.*—Oliver points out that the principle of ascertaining arterial pressure by the force which is needed completely to close the vessel is vitiated by the resistance of the overlying tissues (this, however, is not admitted by many authorities), as well as by the different anatomical relationships of different arteries. The hæmodynamometer, which consists of a pad containing fluid actuating a spring manometer, gives readings on a dial. The first intention of the inventor was to eliminate the above fallacies by using the instrument to indicate the pressure required to evoke a maximum oscillation of the indicator, which is regarded as the criterion of the diastolic blood pressure. He finds, however, that in using the instrument two maximum oscillations of the needle occur, separated by a period of lessened excursion. He looks on the second of these maxima as indicating the systolic pressure. The following directions are given for the use of the hæmodynamometer:—

“The right arm on its ulnar side is placed on a table (this being on a level with the ensiform cartilage in the sitting posture, and with the back in the recumbent position), and the wrist is kept bent to the angle of forty-five degrees by the observer's left hand holding back that of the patient. The feet of the slide [of the hæmodynamometer] are so placed as to elude the track of the artery, and the pad of the instrument is placed over the vessel *at right angles to its bed*. Pressure is then made by gently and gradually pushing forward the body of the instrument by the thumb of the observer's right hand holding the slide. The indicator will then rise on the dial and show the degree of pressure brought to bear on the pad and the vessel, and will begin to pulsate when measuring 50, 60, 70, or 80 mm. or so. The pulsations gradually increase in size as the indicator is made to rise farther on the scale, until the lower maximum point is reached (diastolic reading), beyond which they gradually diminish, and again increase under a higher pressure until a second maximum oscillation is produced (the systolic reading), after which they finally decrease. The readings are made at the midway point of the maximum oscillations.” It is easier to read accurately when the oscillations are small, hence the ulnar artery or the superficialis volæ may be employed instead of the radial. The hæmodynamometer gives identical readings to the armlet method, except when the brachial artery is sclerosed, in which case the armlet readings, particularly the systolic pressure, are higher.

3. *Gärtner's Tonometer.*—This may be instanced as a typical



apparatus based on the principle of using a band encircling a finger to estimate the pressure. It consists of a metal collar lined by an elastic membrane, with arrangements for pumping air between the elastic membrane and the metal, and for measuring the pressure in the air-containing space. The collar is placed loosely over the middle phalanx of a finger, and the terminal phalanx is blanched by bandaging it from its tip upwards with a piece of rubber tubing. Air is then pumped into the elastic bag lining the collar until the manometer indicates a pressure above that of the blood, *e.g.* 200 mm. Hg. The rubber bandage is then unwound, leaving the end of the finger pale and bloodless. Next, the air is allowed to escape slowly from the collar until the finger tip shows a return of the circulation. The manometer reading at this point indicates the systolic arterial pressure. The tonometer is adapted for use either with a mercurial or an aneroid manometer.

4. *Riva-Rocci Sphygmomanometer*.—In this appliance the pressure is measured by means of an armlet encircling the whole upper arm, and an apparatus of this type is now regarded as giving the most reliable information on the arterial pressure. The Riva-Rocci sphygmomanometer has been extensively employed, and numerous modifications of it exist. The armlet, which should measure 12 cm. in width, consists of a distensible bag capable of surrounding the arm, enclosed in a rigid leather or canvas outer case. It is connected with a pump and a mercurial manometer. Air is forced into it until the radial pulse stops; the air is then allowed to escape slowly, and the pressure noted at the time when the pulsation of the radial returns.

Hill and Barnard have modified the apparatus by improving the armlet and substituting a compressed-air or an aneroid for the mercurial manometer. In Janeway's instrument the manometer is jointed for convenience in carriage, and in Erlanger's model a recording apparatus is included.

5. *Oliver's Compressed Air and Spirit Hæmomanometer* is a recent pattern, and its inventor claims for it advantages over both mercurial and aneroid forms. Omitting minor details, the leading features of the instrument are—(1) a full-sized armlet, 12 × 16 cm.; (2) a compressor (pump), actuated by a rapid screw, which inflates the armlet steadily, not intermittently as the ordinary pump does; (3) the recorder, consisting merely of a glass tube, 8 or more inches long, having a capillary bore and a bulb at its upper end. The lower end is V-shaped, and forms a smaller bulb. The tube can be moved from the horizontal to the vertical position. Tinted absolute alcohol is used as an indicator. To use the instrument the recorder is placed in the horizontal position, the spirit reaching the zero mark. The tube of the armlet is connected with it, and air is pumped in. The pressure is estimated by the distance the spirit is driven along the recorder against the resistance of the contained column of air.

6. G. A. Gibson has introduced a *recording sphygmomanometer*, giving absolute records of the arterial pressure. In Erlanger's instrument the pressure readings have to be written on the tracing by the observer, but in Gibson's apparatus the absolute pressure is recorded. The instrument is of the Riva-Rocci type. On the mercury there is a float furnished with an aluminium rod, topped by a style writing on a revolving drum. Another style traces on the drum an abscissa, marking the zero point of the mercurial column. A tambour, connected with a



writing lever, is strapped over the radial artery, and records the movements of the pulse on the drum. In using the instrument the armlet is inflated by steady strokes of the pump until a pressure of 160 mm. Hg or thereby is attained. If sufficient pressure has been employed, the pulsations of the artery below the armlet are checked, and the pen recording these remains stationary. The drum is then caused to revolve, and the air is allowed to escape slowly from the armlet through a valve. The point of maximum (systolic) pressure is recorded by the first appearance of small waves in the radial tracing. The minimum (diastolic) pressure is taken as the lowest point of the largest wave in the manometer trace. As there is a double column of mercury in the V-tube of the manometer, the height of the tracing above the abscissa has to be doubled to give the absolute pressure.

MEASUREMENTS OF VENOUS PRESSURE.—Oliver gives the following as a ready clinical method of estimating the venous pressure. The hand being held vertical, and below the apex beat, slowly raise it and note the height in inches above the apex beat at which the veins in the dorsum are seen to collapse. The number of inches multiplied by two gives approximately the pressure in mm. Hg.

CLINICAL SPHYGMOMANOMETRY.—The *maximum (systolic) pressure* is estimated by the pressure required to obliterate the artery completely. It can therefore be determined (*a*) by noting the pressure on the brachial artery which abolishes the pulse at the wrist; or (*b*) the radial pulse being abolished, by allowing the air to escape slowly from the armlet, and noting the point at which the pulse returns at the wrist.

The *minimum (diastolic) pressure* is usually measured by noting the point at which the oscillations of the manometer attain the highest amplitude. According to Leonard Hill, this point of maximum oscillation represents not the minimum, but the mean blood-pressure. Most clinicians, however, take the *mean pressure* to be midway between the minimum and maximum pressures, as defined above. Another method of determining the minimum pressure is by observing the point at which the volume of the radial pulse first becomes sensibly less. This may be done either by the finger or sphygmograph. The method is less reliable than the first mentioned.

The normal maximum pressure in the brachial artery during rest is 110-130 mm. Hg, the minimum 95-100 mm. Hg. Oliver gives as a good average reading for an adult  $\frac{115-125 \text{ S.}}{95-100 \text{ D.}}$ ; readings of  $\frac{95-145 \text{ S.}}{80-115 \text{ D.}}$  are within normal limits. In children they approximate to the lower, in persons over middle life to the higher, of these figures. In women the readings are from 5 to 10 per cent. less than in men. The difference between the maximum and minimum pressures is the *pulse-amplitude*; it is from 10 to 40 mm. Hg, the average being about 25 mm. The mean pressure is taken as the arithmetical mean of the maximum and minimum pressures.

The blood-pressure is raised by muscular exercise; it falls after exercise. Cold contracts the peripheral vessels and raises the pressure; warmth has the opposite effect. After a meal the pressure first rises, then falls; during sleep it falls, then rises. A supernormal pressure is much more common than a subnormal pressure. It seems as though the normal degree of pressure is pretty near the minimum at which life can be constantly sustained, and every effort is made to uphold it (Hutchison).



High arterial pressure occurs as a result of senility. After middle life the systolic pressure in particular tends to rise; the diastolic rises more gradually, or may for a time remain normal. The chief conditions in which persistent supernormal arterial pressure is met with are arterio-sclerosis and chronic interstitial nephritis. The pressure is also raised in many forms of neurasthenia, in melancholia, in insomnia, in cerebral hæmorrhage, in angina pectoris, in polycythæmia, and in the crises of locomotor ataxia.

Low arterial pressure is found in collapse, in anæmia, in Addison's disease, in diphtheria, in typhoid, and in exhausting diseases generally. In pneumonia a sudden rise before the crisis presages a complication; a sudden fall, heart failure (G. A. Gibson). Aortic incompetence is characterised by a high systolic and a low diastolic pressure.

In typhoid fever the blood-pressure is usually low—below 100—and if it remains fairly steady during the course of the disease, Barach (*New York Med. Journ.*, p. 348, 1907) looks on the prospects of the patient as favourable. A steady fall, on the other hand, is a bad sign. Equally ominous is a sudden rise, which is said by Huchard (*Rev. de med.*, p. 609, 1907) to precede hæmorrhage or perforation. When perforation actually occurs there is a rise in the blood-pressure to 160 or 200 mm. Hg. (Shephard. *Lancet*, i. p. 1293, 1907).

The whole subject of arterial pressure, and the inferences to be drawn from sphygmomanometric observations, is an extremely difficult one. The blood-pressure depends on many factors: the force and output of the left ventricle; the peripheral resistance; the elasticity of the arteries; and the volume of blood in the circulation. Variations in any of these will cause alterations in the pressure. The difficulties introduced by thickening of the walls of the vessels, and by arterial hypertonus, are discussed under ARTERIO-SCLEROSIS and ARTERIAL HYPERTONUS, and will not be further mentioned here, except to say that great difference of opinion exists as to what part a thickened artery plays in vitiating the correctness of a high reading as a witness to the state of matters inside the artery.

Müller sums up the main problem in the diagnosis diseases of the circulation thus:—To discover a ready clinical means of estimating changes in the volume of the heart beat (*Schlagvolumen*), on the one hand, and changes in total sectional area of the vessels on the other. Unfortunately (he says), the comparatively simple methods of sphygmomanometry do not furnish the necessary information.

Strasburger has made an effort in this direction. He assumes that the brachial pressure is identical with that of the aorta. It alters (*a*) with changes in the volume of blood expelled by the ventricular contractions, and (*b*) with contraction and expansion of the sectional area of the peripheral vessels. Strasburger further takes the pulse amplitude (*Pulsdruck*), defined above as the difference between the maximum and minimum pressures, as a measure of the volume of blood expelled by each ventricular contraction—factor (*a*) above. When the volume varies, so does the pulse amplitude; when it remains constant the pulse amplitude does the same. The sectional area of the vessels—factor (*b*) above—is measured by the minimum blood-pressure. The relation of the two factors is expressed as the *blood-pressure quotient*



$\frac{\text{Pulse amplitude}}{\text{Diastolic pressure}} = Q.$  Thus  $\frac{P. A. = 25-30}{D. P. = 80-100} = \text{about } \cdot 3$  on the average. On this basis he formulates the following general statements:—

1. When the systolic pressure alters and the quotient remains the same there is alteration in the work of the heart. S. P. + = increased work; S. P. - = diminished work.

2. When both the systolic pressure and the quotient *vary equally in opposite directions*, there is alteration in the vascular tone. S. P. + and Q. - = increased tone; S. P. - and Q. + = lowered tone.

3. When both the systolic pressure and the quotient *vary in the same direction or unequally in opposite directions* both the work of the heart and the tone of the vessels are altered.

A very important practical point in connection with supernormal arterial pressure is made by Janeway, namely, that high arterial pressure is often a necessary evil, being a compensatory effort of the organism. In some patients "an average level of arterial pressure far above the normal is absolutely necessary to insure the requisite speed of capillary blood-flow. For them the optimum pressure for the maintenance of a normal circulation may become 200 mm. or more, instead of 100 to 145 mm. . . . a systolic pressure of 200 mm.—yes, even 250 mm. and over—is not incompatible with a number of years of comparative comfort and activity, particularly if the response to treatment is favourable, and the patient co-operates heartily."

TREATMENT OF SUPERNORMAL PRESSURE.—The following are the main points as laid down by Oliver:—1. Reduce the bulk of the meals and eliminate articles which stimulate the circulation—alcohol, condiments, extractives. 2. Reduce the proteid of the diet, and the fluid drunk. 3. Encourage thorough mastication. 4. Moderate use of tea and coffee. Forbid alcohol. 5. A lacto-farinaceous diet for a period of several weeks is sometimes useful. 6. Tobacco should be prohibited, as it causes the pressure to rise. 7. There should be a period of absolute rest, followed by carefully graduated exercise. 8. Various forms of baths are useful. 9. The cutaneous function should be attended to. The bowels ought to be evacuated freely. Intestinal antiseptics may be given. 10. Vaso-dilator drugs—thyroid and nitrites.

ACTION OF THE NITRITES.—The action of the different nitrites in high blood-pressure has been worked out comparatively by Matthew. He finds that liquor trinitrini (Mii) produces an average fall of 28 mm. Hg within 5 minutes; the action is short-lived, the pressure regaining its old level in half an hour. Sodium nitrite (2 grs.) produces an average fall of 32·5 mm. Hg in a quarter of an hour. The effect lasts longer, and the old level is not reached until 1 to 2 hours has elapsed. Erythrol tetranitrate (1 tablet) produces an average fall of 34 mm. Hg in 22 minutes. The pressure remains low for 1 to 2 hours, and the effect does not wholly pass off for from 4 to 6 hours.

LITERATURE.—The following are some of the chief sources of information.—OLIVER. *Studies in Blood-Pressure*, 2nd ed. (Lond.), 1908.—JANEWAY. *New York Med. Journ.*, Feb. 2, 1907; *The Clinical Study of Blood-Pressure* (Lond.), 1905.—STRASBURGER. *Zeitsch. f. klin. Med.*, liv. p. 373, 1904; *Deutsch. Arch. f. klin. Med.*, Heft. 3 and 4, 1907.—MULLER. *Ergeb. d. inn. Med. u. Kinderheilk.*, ii. 1908 (bibliography).—GIBSON. *Quarterly Journ. Med.*, Oct. 1907.—MATTHEW. *Ibid.*, April 1909.—LAUDER BRUNTON. *Therapeutics of the Circulation* (Lond.), 1908.—HUTCHISON. *Applied Physiology* (Lond.), chap. v., 1908.—RUSSELL. *Arterial Hypertonus and Blood-Pressure*, ed. 1907.—LEONARD HILL and FLACK. *Brit. Med. Journ.*, Jan. 30, 1909.



**Broad Ligaments of the Uterus.**—The advances in our knowledge of the broad ligaments of the uterus which have been made during the past few years are most conveniently described under ECTOPIC PREGNANCY, under PELVIS (Diseases of Cellular Tissue and Peritoneum and Hæmatocele), and under UTERUS (Displacements and Inflammations). The reader is referred to these articles. At the same time, there are one or two matters which may be alluded to here.

The parovarium must still remain among the embryonic relics to which no function has as yet been ascribed; it lies, as has been said, on the “dust heap of the useless relics” of the human body. Time will show whether it may not yet be rescued therefrom by some physiologist, and placed, like the suprarenal capsule, the thyroid gland, and the pituitary body, among the structures which profoundly influence the working of the whole system by the elaboration of an internal secretion or otherwise. In the meantime, its interest is a purely pathological one, and it is, owing to its tendency to form cystic growths, a dangerous, or at any rate a troublesome, relic.

Varicocele of the broad ligament (parovarian or tubo-ovarian varicocele) is a varicose condition of the veins of the mesosalpinx. Phleboliths in the broad ligament of the uterus may thus be produced. It is the homologue of varicocele in the male, but apparently occurs with much less frequency, perhaps because the ovarian veins follow a horizontal instead of a vertical course (Ashton, *Gynecology*, p. 549, 1905). It forms a mass in the broad ligament (usually the left), varying in size from a walnut to a hen's egg, and very often gives rise to no symptoms, although lancinating pains, obstinate menorrhagia, and recurrent abortion have been recorded. Pain and discomfort are relieved by the recumbent posture, but are made worse by any form of exercise. It is hardly ever diagnosed prior to operation (abdominal section), for its only physical sign is the presence of a soft compressible swelling in the region of the appendages (as detected by the recto-abdominal bimanual examination), which becomes smaller when the patient lies down. There is always danger of rupture of the enlarged veins, although, of course, pelvic hæmorrhage from this cause is much less frequent than from ectopic pregnancy. If tubo-ovarian varicocele exist apart from tubal and ovarian disease, each vein should be tied separately and then the whole mass removed without sacrificing the uterine annexa. Reed's operation (C. A. L. Reed, *Gynecology*, p. 685, 1904) consists in ligaturing the plexus of veins in sections and incising the veins between the ligatures. Of course if the tube or ovary be diseased the ordinary operation of salpingo-oophorectomy is performed. Camusset (*Thèse de Lyon*, 1908-9) gives a good account of this morbid state of the broad ligament, and Michel and Bichat's article (*Arch. gén. de méd.*, i. for 1903, p. 1419) may also be referred to.

## Cæsarean Section.

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DURING the past few years, since the beginning of the twentieth century, a tendency to extend the sphere of Cæsarean section has been evidently present, and, with this, there have been sundry alterations in the



technique of the operation, some of which, at least, are likely to be permanently retained. Two obstacles remain, the effect of which is to check obstetricians who are desirous of performing the Cæsarean section still more frequently; I refer to the patient's (or her husband's) right of veto, and to the unsatisfactory results which have followed the carrying out of the operation late in labour after attempts have been made to deliver the patient in other ways.

INDICATIONS.—There has been a manifest tendency to increase the number of conditions which should be regarded as indications for the performance of Cæsarean section.

(1) *Placenta Prævia*.—Lawson Tait proposed Cæsarean section as a possible method of treatment in cases of placenta prævia, but at first no one was bold enough to adopt the suggestion. Reports of cases slowly began to appear; Bernays (*Journ. Amer. Med. Assoc.*, xxii. p. 687, 1894) recorded the first successful case in 1894, and in 1902 Zinke (*Amer. Gynec. and Obstet. Journ.*, xix. p. 334, 1901) was able to refer to eight sections for placenta prævia in which five mothers and six infants were saved. In six of the eight cases the ordinary Cæsarean section was employed and in two Porro's modification. In 1902, Carbonelli (*Progresso Med.*, i. p. 158, 1902) reported three cases; Ehrenfest (*Amer. Med.*, iii. p. 64, 1902), on the other hand, regarded the operation as an improper one in placenta prævia. The operation was thought by its supporters to be specially appropriate in a primipara, with a closed os, with the central variety of placenta prævia, in whom the hæmorrhage was profuse and could not be controlled with tampons. If the Porro operation were performed, an additional advantage was gained in the removal of an organ which might very easily have become septic. Since 1902 there has been little progress in the establishment of placenta prævia as a legitimate indication for Cæsarean section. In 1907 Jardine of Glasgow (*Journ. Obstet. and Gynec. Brit. Emp.*, xiv. p. 399, 1908) performed the ordinary Cæsarean operation successfully in a case of twins with placenta prævia, but the indication was a contracted pelvis and not placenta prævia; and the writer stated that he would never feel justified in doing this operation in an ordinary case. Zweifel (*Münch. med. Wochens.*, liv. p. 2361, 1907) is also opposed to this method of treatment. Munro Kerr (*Operative Midwifery*, p. 594, 1908), however, thinks that in certain exceptional cases of placenta prævia it might be justifiable to perform Cæsarean section; he refers to "old primiparæ, where the hæmorrhage occurs at full time and before labour has started, and where, to judge by the condition of the parturient canal and the size of the child, delivery would be tedious and difficult." Sellheim (*Gynaek. Rundschau*, iii. p. 61, 1909) proposes, not the ordinary Cæsarean section, but the extra-peritoneal incision of the uterus (suprasymphysary hysterotomy), in order to reduce the mortality (maternal and foetal) in placenta prævia. If, however, we strive to form a fair estimate of the present position of this suggested indication, it must be owned that its supporters have not established a strong claim. In the course of a discussion on Cæsarean section in placenta prævia before the American Gynecological Society last April (*Amer. Journ. Obstet.*, lix. pp. 937-961, 1909) H. D. Fry stated that forty-three cases had been operated on, with a maternal mortality of 16·3 per cent., and that in the thirteen reported since 1905 the death-rate had fallen to 7·7 per cent. Some of the speakers thought there was a limited field of usefulness for the operation. Recently, *vaginal* Cæsarean section has been performed several times for placenta prævia (by Dührssen,



Caturani, Weisbein, and Büttner); but this is quite a different matter, although it may be said that it has met with even less approval.

(2) *Accidental Hæmorrhage*.—For accidental hæmorrhage when the bleeding is concealed, the os closed, and the uterus inert, it would seem that Cæsarean section, or rather the supravaginal form of hysterectomy, might fairly be considered. Munro Kerr (*op. cit.*, p. 606) treated two cases in this way, but both proved fatal. Targett (*Journ. Obstet. and Gynec. Brit. Emp.*, vii. p. 344, 1905), however, had a successful case at the sixth month of pregnancy; but the patient's recovery was greatly delayed by parametritis and thrombosis, and the writer states that on reflection he thinks this would have been a suitable case for the *vaginal* rather than the abdominal operation. W. Rühl (*Zentralb. f. Gynäk.*, xxv. p. 1283, 1901) and Bumm (*ibid.*, xxvi. p. 1417, 1902) and others have accordingly performed vaginal Cæsarean section for this form of antepartum hæmorrhage: the mothers in Rühl's and Bumm's cases recovered. F. Montuoro (*Il Taglio Cesareo ed il Parto Forzato* (Genova), p. 190, 1904), thinks that the Bossi dilator gives better results in such cases than Cæsarean section, abdominal or vaginal. It is not very easy to forecast the future in regard to this indication for Cæsarean section; for accidental hæmorrhage may be so serious a complication of pregnancy and labour as to justify extreme measures. There is, however, an evident reluctance among obstetricians to perform the conservative abdominal operation in these rare cases, and a tendency to remove the uterus (supravaginal hysterectomy) or to have recourse to vaginal Cæsarean section (anterior hysterotomy).

(3) *Eclampsia*.—It has been stated elsewhere (see ECLAMPSIA) that whilst vaginal Cæsarean section has been widely adopted in the treatment of eclampsia, the ordinary abdominal operation has been little used, and has generally had unfortunate results. Montuoro (*op. cit.*, pp. 106-109), writing in the year 1904, was able, however, to give a list of sixty-two cases, in most of which the conservative Cæsarean section was performed (the Porro method was used in four cases), with a maternal mortality of thirty-five (56 per cent.), an immediate foetal mortality of 27·5 per cent. and a later one of 36·3 per cent. Obviously this is a very high mortality, and it can hardly be fully explained by the statement that only the most serious cases of eclampsia are submitted to Cæsarean section. Notwithstanding the large number of deaths that have occurred, "there is now," writes Munro Kerr (*Operative Midwifery*, p. 404, 1908), "a general consensus of opinion that in certain cases—they are, of course, few in number—Cæsarean section is not only permissible, but is actually the treatment indicated;" further, the cases are those in which "the eclamptic seizures are of great severity and frequency in the later weeks of pregnancy, and, above all, when the cervix is not taken up and is very rigid and undilatable."

(4) *Contracted Pelvis*.—Pelvic deformity is, of course, no new indication for the performance of Cæsarean section; the novelty consists in the extension of the range of applicability of the operation. It is now generally admitted that a true conjugate of less than  $2\frac{1}{4}$  inches is an absolute indication for Cæsarean section; but what of the pelvis with a conjugata vera of  $2\frac{1}{4}$ ,  $2\frac{1}{2}$ , or more? Two somewhat opposed tendencies are in existence at the present time, and their opposition makes it difficult to answer the above question definitely and directly. In the first place, there is the assertion which is constantly being made that craniotomy or embryulcia in the case of the living foetus is unjustifiable,



and the conclusion would appear to be that in all the cases in which craniotomy was formerly performed, and in which the foetus is alive, Cæsarean section should be substituted. Theoretically, and from the high ethical standpoint, this is the only conclusion to which one can come; to save a mother from certain death it may be justifiable to destroy her unborn infant, but to do it simply in order to diminish the risk of delivery when the risk is not more than, say, 8 or 10 per cent., is indefensible. On the other hand, however, there is a tendency which is becoming more accentuated to refuse the Cæsarean section to women who come under treatment when advanced in labour and having been previously interfered with. Munro Kerr (*op. cit.*, p. 404, 1908) writes: "In recent years I have made it a rule never to perform Cæsarean section in cases which have been interfered with prior to their coming under the care of myself or my assistants, unless the deformity of the pelvis is so extreme as to render craniotomy impossible, or more dangerous to the mother than Cæsarean section; I am compelled, therefore, not infrequently to perforate a living child." Further, there is the difficulty of obtaining the consent of the patient or her husband to the performance of Cæsarean section, while the facility with which one is permitted to do craniotomy is notorious. About this matter Galabin says (*Brit. Med. Journ.*, ii. for 1902, p. 1125): "A doctor may refuse to perform repeated inductions of abortion for contracted pelvis, and he may decline to attend a labour if the patient is unwilling to follow his advice; but having engaged to attend, and labour having begun, may he refuse to perform embryotomy, if he thinks Cæsarean section the right treatment, and throw up the case if the patient refuses to accept his advice? I should say certainly not, unless he is sure that the patient can obtain other assistance, and I should not myself approve such a course in any case." Now, if one places these opinions fairly before one's mind, the conclusion would seem to be that it is not possible at once to make a clean sweep of craniotomy upon the living foetus, but that it is desirable that its performance should be strictly limited, and that it be gradually replaced by Cæsarean section or by the induction of premature labour (in a subsequent pregnancy). In order that this change in practice may be brought about, the obstetric specialist must still further reduce the mortality following Cæsarean section; and, in order that he may play his part, the general practitioner must make an early diagnosis of disproportion between the foetal head and the maternal pelvis in his confinement cases, must refrain from interference with forceps and other attempts at delivery, and must indeed send his patient to the specialist, or bring the latter to her, before the commencement of the second stage of labour. Obviously the diagnosis during pregnancy of so marked a pelvic deformity as will make the passage of a full-time living child through the pelvis impossible is of the highest importance; and it may well be that the first step in the abolition of embryulcia in labour will be the routine performance of pelvimetry in pregnancy. If the impending presence of disproportion between the maternal pelvis and the foetal head be discovered about the sixth or seventh month of pregnancy, the medical practitioner will be able to place before his patient and her friends the alternatives of induction of premature labour or of Cæsarean section at the full term. In this way he will have leisure calmly to consult his patient's best interests and those of her child, and in this way it is likely that the performance of Cæsarean section may be more often chosen for the cases of pelvic contraction in which the *conjugata vera* measures



from  $2\frac{3}{4}$  to  $3\frac{1}{2}$  inches. Of course other matters must also be considered, such as the type of pelvis, for, given two pelvises with equal conjugates, one a simple or rachitic flat and the other a generally contracted, Cæsarean section will be more likely to be needed in the latter than in the former (see Jardine, *Brit. Med. Journ.*, ii. for 1908, p. 800). In the midst of all the discussion which is going on at present about the widening of the indications for the performance of Cæsarean section in cases of moderate pelvic contraction, one must keep constantly in view that an improvement in the results of the induction of premature labour so far as the infants are concerned would at once alter all our views, and force even the continental obstetricians, who are so insistent upon Cæsarean section, to reconsider their position. It must not be forgotten that it is solely the high infantile mortality that prevents induction of premature labour being the operation of choice in many of the cases in which Cæsarean section is being so vehemently urged. It may here be added that it has been established to the point of demonstration that Cæsarean section may safely be performed several times on the same patient, and Fruhinholz (*Ann. de gynéc. et d'obstét.*, xxxiii. p. 135, 1906) and Sinclair (*Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 337, 1907) have shown that, even when utero-parietal adhesions exist, their presence will not contra-indicate the repeated performance of section, although difficulties will thus be introduced. There have, of course, been cases of rupture of the cicatrix in subsequent pregnancies, as in Convelaire's case, in which the gestation was complicated by hydramnios (*Ann. de gynéc. et d'obstét.*, xxxiii. p. 148, 1906); but these have been surprisingly infrequent (only eight between 1896 and 1905 according to Convelaire). During the past few years a great many contributions to the subject of the extension of Cæsarean section in moderate degrees of pelvic contraction have been made, and in addition to the references already given the reader may consult the following:—Pfannenstiel (*Med. Bl.* (Wien), xxix. p. 613, 1906); Bauer (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiv. p. 713, 1906); Davis (*Surg. Gynec. and Obstet.*, iii. p. 593, 1906); Kholmogoroff (*Russk. Vrach*, v. p. 1372, 1906); Everke (*Verhandl. d. deutsch. Gesellsch. f. Gynäk.*, p. 546, 1906); Wallace (*Practitioner*, lxxviii. p. 337, 1907); Leopold (*Arch. f. Gynaek.*, lxxxix. p. 702, 1907); Seiffart (*Zentralb. f. Gynäk.*, xxxi. p. 956, 1907); Calderini (*Ginecologia*, iv. p. 261, 1907); Kynoch (*Edin. Med. Journ.*, N. S. xxii. p. 221, 1907); Canton (*Ann. de gynéc. et d'obstét.*, 2 s. iv. p. 542, 1907); Reynolds (*Boston Med. and Surg. Journ.*, clvii. p. 581, 1907); Reid (*New York State Journ. Med.*, viii. p. 3, 1908); Gushee (*Bull. Lying-in Hosp.* (New York), iv. p. 91, 1907); Halpenny (*Amer. Journ. Obstet.*, lvii. p. 713, 1908); Reynolds (*Amer. Journ. Obstet.*, lviii. p. 231, 1908); Hirst (*ibid.*, p. 128); Smith (*Surg. Gynec. and Obstet.*, vii. p. 25, 1908); M'Pherson (*Journ. Amer. Med. Assoc.*, li. p. 734, 1908); Frederick (*Amer. Journ. Obstet.*, lviii. p. 847, 1908); Küstner (*Zeitsch. f. Geburtsh. u. Gynäk.*, lxiii. p. 407, 1908); Allen (*Amer. Journ. Obstet.*, lix. p. 189, 1909).

**METHODS.**—At the present time four methods of performing Cæsarean section (excluding the so-called vaginal Cæsarean section) are in use; these are as follow:—

1. There is first what may be called the *old Porro operation*. At one time this method enabled the operator to obtain much better results than had previously been obtained; but it is now abandoned by nearly everyone, and is carried out only in septic cases. The uterus was opened either before or after it was turned out of the abdomen; the



child was removed; the uterus was amputated supravaginally, an elastic ligature having been tied round the upper part of the cervix to control the hæmorrhage; the ovaries and tubes were removed with the uterus; the uterine stump was then fastened into the lower end of the abdominal incision, at first by means of one or two long straight needles fixed at right angles, and later, as the technique was perfected, by stitching the peritoneal covering of the stump to the peritoneum of the abdominal wall; the rest of the abdominal wound was closed; and in time the stump, with the ligature round it, sloughed off, leaving a depressed wound, which slowly healed by granulation. This extra-peritoneal method gave better results than the ordinary unimproved conservative Cæsarean section, but it was far from perfect; there was often trouble with the stump, and of maternal deaths there were not a few.

2. What has been called the *new* or *modified Porro operation* is practically a supravaginal hysterectomy, such as is commonly carried out in cases of fibroid tumour, with retro-peritoneal or sub-peritoneal treatment of the stump. The infant is extracted from the uterus; then, the patient having been placed in the Trendelenburg position (although this is not always necessary), the empty organ is brought out of the abdomen, and hæmorrhage from the incision in it checked by a long clamp or by swabs. First on one side, and then on the other, the round ligaments and the ovarian vessels in the upper part of the broad ligaments are ligatured. Munro Kerr (whose description is here in the main followed, *Operative Midwifery*, p. 419) applies a second ligature to the ovarian vessels for safety, and clamps the broad ligaments close to the uterus as well. The ligatures are, of course, placed internal to the ovaries, if it has been decided to leave these glands. The broad ligaments are then divided between the ligatures and the clamps, and the securing of the uterine vessels is proceeded with. These vessels can be felt well down in the wound, and should be tied near the cervix, so as to avoid wounding or including the ureters. A good plan is to divide transversely the peritoneum covering the anterior surface of the uterus, raise the lower part of it with the bladder and push it well forward, and divide also the peritoneum on the posterior surface of the uterus; this procedure, by opening up the lower part of the broad ligaments, enables the operator to see the uterine vessels, which can then be ligatured with greater certainty and safety. Having tied these vessels and any others of sufficient size the operator can now cut across the uterus in its upper cervical portion. If the stump thus produced be very wide, a wedge-shaped portion (including the mucosa of the cervical canal) can be cut out of its centre; the anterior and posterior parts of the stump are then stitched together (with catgut), the peritoneum brought over the whole with a layer of sutures, and the opened-up parts of the broad ligaments closed in with a few stitches, so as to prevent the exposure of any raw surfaces. The stump is now allowed to fall back into the pelvis, the abdominal cavity is cleansed, and the abdominal wound is closed (preferably in layers, if there be sufficient time). Occasionally, as in cases of cancer of the cervix or of septic infection of the uterus, the whole organ is removed by panhysterectomy. Instead of amputating the uterus supravaginally after the uterine arteries are tied, the vaginal canal is opened into through the pouch of Douglas posteriorly, whilst in front the bladder is pushed forwards from off the cervix, and the anterior fornix vaginæ opened into; then the tissues still attaching the uterus at the sides are



clamped, and the whole organ is cut away; any vessels that bleed are secured, and the anterior and posterior vaginal walls are stitched together, the pelvic peritoneum being brought over the line of sutures and fixed in position, so restoring the integrity of the peritoneal cavity. Both these forms of Cæsarean section (supravaginal and pan-hysterectomy) are especially useful when there is a risk that septic infection of the uterus has already taken place, or when the organ is diseased in some other way, or is the seat of a fibroid or a malignant growth. In both it will be well to leave one or both ovaries, so that the patient may not lose the ovarian secretions.

3. The third method is known as the *conservative Cæsarean section* as modified by Säger, Murdoch Cameron, and others. It is the operation which is commonly performed at the present day, and it is undoubtedly the operation of election in the cases which are seen early, either during the last days of pregnancy or in the first stage of labour, and in which the chances of septic infection are few. In it the abdomen is opened, and then the uterus, the child, and placenta are extracted; the uterus is closed by means of sutures, and the operation is brought to an end by the suturing of the abdominal incision. The technique is well known, has been fully described in the *Encyclopædia Medica* (Vol. VIII. pp. 541-545), and need not, therefore, be described here; but certain details have recently been made the subject of discussion and require to be referred to. There is, first, the question of the position and direction of the *uterine incision*. The usual incision is in the anterior wall of the uterus and runs longitudinally, but several others have been recommended and practised. Thus a posterior longitudinal one has been advocated; so has a posterior longitudinal one low down, with an opening for drainage into the vaginal canal; so has a transverse incision low down anteriorly; so has a fundal incision running in a sagittal direction; and, finally, so has the most discussed of them all, the transverse fundal incision of Fritsch. H. Fritsch made his suggestion twelve years ago (*Centralb. f. Gynäk.*, xxi. p. 561, 1897), and described a case in which he practised it; G. Braun (*ibid.*, p. 1351) soon thereafter described another; and then for some five or six years (till 1902 or 1903) an animated discussion on the comparative merits of the longitudinal anterior and of the transverse fundal incision took place, as a glance through the annual volumes of the *Centralblatt für Gynäkologie* abundantly shows. In 1902 it began to be possible to form a calm judgment upon the question at issue, some of the initial excitement having died down; and Munro Kerr (*Brit. Med. Journ.*, ii. for 1902, p. 1129) made a well-reasoned contribution to the subject in an article, in which he referred to six cases in which he had practised the fundal incision. He took up in turn the five advantages which Fritsch had claimed for his incision—these were, less risk of subsequent hernia on account of the higher position of the abdominal wound, the fact that the abdominal cavity could be kept cleaner, less amount of bleeding, contraction of the uterine incision, and greater ease in the extraction of the child—and showed that only one of them (the last) was really of much importance. Further, Munro Kerr pointed out that against this single advantage (greater ease in extracting the infant) had to be placed the tendency there was for the uterus to become attached higher up to the abdominal wall and to remain larger. On the whole, he was prepared to state that the best incision for ordinary cases was an anterior longitudinal one made *high up* in the uterus; but the trans-



verse fundal cut might be found useful in cases in which the uterus was to be removed. There is a second detail in the performance of Cæsarean section which has been the subject of controversy, viz. coincident *sterilisation of the patient*. The question which has arisen is this: If the uterus is left, ought means to be taken to prevent a subsequent pregnancy, and if so, what is the best method of procedure? It has been urged by many that sterilisation should accompany Cæsarean section, because of the danger of rupture of the uterus in a subsequent pregnancy, and because of the increasing risk of repeated sections; on the other hand, it has been stated that if the uterine wound be carefully sutured there is little danger of rupture (and certainly not many cases of rupture have been reported), and that the repeated operation is, as a matter of fact, less dangerous than the primary one, because of the presence of adhesions between the uterus and the anterior abdominal wall, which shut off the peritoneal cavity and enable the obstetrician to carry out the operation extra-peritoneally (Sir Wm. Sinclair, *Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 335, 1907). So far, however, as the surgical question is concerned, it must be admitted that the arguments in favour of sterilisation are the stronger ones, for it cannot be maintained that subsequent pregnancies and Cæsarean sections are as safe as subsequent sterility. The ethical question is a much more open one. Some have said that the right plan is not to sterilise but to tell the patient and her husband the possible results of a subsequent pregnancy and a repeated Cæsarean section, and so to shift the responsibility on to their shoulders (Green, *Amer. Journ. Obstet.*, xlvii. p. 773, 1903); others have recommended sterilisation in pauper patients, but not in those of the better class until the operation has been twice performed (Whitridge Williams, *ibid.*); and yet others have taken the high ground that the obstetrician's duty is to deliver his patient as safely as he can and leave her organs in as natural a condition as possible, repeating the operation of Cæsarean section when called upon to do so (Spencer, *Trans. Obstet. Soc. Lond.*, xlv. p. 334, for 1904). Sir Wm. Sinclair (*Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 342, 1907) is of the same opinion. Galabin (*Brit. Med. Journ.*, ii. for 1902, p. 1124) says, "I think it right to leave to the patient the decision as to whether she should be sterilised for the future; considering that, if a woman is so formed by Nature, that she cannot bear a child spontaneously, she is entitled to be relieved from the perils of artificial delivery." The question of sterilisation is obviously a very difficult one, especially from the ethical side; but, on the whole, the progress of events and the trend of opinion would seem to be in the direction of carrying it out in as few cases as possible. The next question has reference to the best method of sterilising, if the procedure be determined on. There are three plans—removal of the ovaries, supravaginal amputation of the uterus, and resection of the Fallopian tubes. Save in the case of osteomalacia (where there is evidence that removal of the ovaries checks the progress of the bone disease) the first of these procedures is not usually followed; the value of the ovarian secretion in the general economy of the body is now too well known and appreciated for it to be lightly dispensed with, and there are, as well, risks of ligatures slipping, etc., which are peculiar to the operation of oophorectomy when conjoined with Cæsarean section. Supravaginal hysterectomy is, of course, a certain method of sterilising the patient, and has the advantage of preserving the ovaries; but it presupposes



a greater amount of operative experience than is usually possessed by anyone save a specialist in obstetrics, and it may turn out that the uterus, like the ovaries, has an internal secretion which is of value in the regulation of the metabolism of the female bodily economy. Further, it is not, of course, available in cases of Cæsarean section. The third method of sterilising the patient, viz. by resection of the tubes, is the most suitable in the great majority of cases of the conservative operation; it consists in ligaturing the Fallopian tubes in two places, and removing the portion of the tube between the ligatures; since it has been known to fail (pregnancy again occurring), it may be well to bring the peritoneum over the openings in the tubes. Munro Kerr (*Operative Midwifery*, p. 425, 1908) points out that this method has an advantage which the other two lack—it may be undone again by operation, if, for any reason, the patient desire to conceive; the abdomen can be opened and the ends of the tubes reunited.

What may be regarded as a fourth method of performing Cæsarean section is the *supra-symphysary extra-peritoneal* plan, or *extra-peritoneal abdominal hysterotomy*. It has also been called *cervical Cæsarean section*, a name which, although correct enough anatomically, is apt to lead to confusion, suggesting, as it does, the vaginal Cæsarean section.  *Sectio Cæsarea abdominalis inferior*, but for its unwieldiness, would be a satisfactory appellation. This new method was introduced by Frank in 1907 (*Arch. f. Gynaek.*, lxxxi. p. 46, 1907), and modified by Sellheim and others in 1908 (*Zentralb. f. Gynäk.*, xxxii. p. 133, 1908). The anterior abdominal wall is cut through by means of a transverse incision (down to the peritoneum) a few centimetres above the symphysis pubis (the patient being in the Trendelenburg position); the peritoneum is then separated from the posterior surface of the bladder and from the anterior surface of the lower uterine segment, and fixed to the parietal peritoneum in the upper margin of the incision; in this way the lower part of the uterus is laid bare, and yet the peritoneal sac is kept closed; a transverse cut is then made into the uterine cavity, and the child and placenta are extracted through it; and, finally, the uterine incision is closed with sutures, the parts restored to their normal relationships, and the abdominal wound closed. A plug of iodoform gauze may be used for drainage. The advantages claimed for this method are that it is done extra-peritoneally, that hæmorrhage is slight, that there is no trouble with the intestines, that the risk of infection of the peritoneal cavity from below is much lessened, that there is an opportunity for the expulsion of the child and placenta by the natural efforts, that the chances of ventral hernia are lessened, and that the patient can rise earlier. Frank reported thirteen cases thus operated on, and in all of them the mother recovered. Sellheim (*Zentralb. f. Gynäk.*, xxxii. pp. 133, 319, 1908) soon afterwards described five cases in which he operated extra-peritoneally, but with some alterations in the technique: he made a transverse concave incision (Pfannenstiel), but only carried it down through the skin and subcutaneous tissue to the fascia; then he split the fascia to the width of the skin incision; then the recti muscles were separated from each other and the peritoneum stripped off their inner surfaces, as also from the surface of the bladder (which had been distended with water so as to carry upwards the reflection of peritoneum). The cervix uteri was then opened into in the middle line by means of a longitudinal incision (not by a transverse one, as practised by Frank), the child and placenta were extracted, and the



incisions closed in the usual way. One of Sellheim's five cases died. Fromme, in Veit's Clinique (*Zentralb. f. Gynäk.*, xxxii. pp. 301, 545, 1908; *Berl. klin. Wochensch.*, xlv. p. 147, 1908), also preferred the longitudinal incision, and reported seven cases; he, however, divided the uterine peritoneum longitudinally and stitched it together again later, and thus avoided the lifting up of the bladder; in fact Veit's later method differed markedly from Frank's. Other modifications were introduced by Baumm (*Zentralb. f. Gynäk.*, xxxii. p. 451, 1908), Czyzewicz (*ibid.*, p. 817), Döderlein (*ibid.*, xxxiii. p. 121, 1909), and Freund (*ibid.*, p. 560, 1909). There had been all along a tendency to divide the peritoneum temporarily, making the operation a trans-peritoneal (rather than a truly extra-peritoneal) one, but Döderlein and Freund endeavoured to ensure an entirely extra-peritoneal approach by entering from the side. It is probable that other modifications will yet be introduced, for, at present, the operation is rather difficult. Sellheim's latest modification, delivery through a *utero-abdominal fistula*, is a long and complicated operation, involving a great deal of preliminary suturing of parietal peritoneum to skin and of uterine peritoneum to parietal peritoneum before the uterus is opened into. It will not replace the ordinary conservative operation for uninfected cases, but it is very likely to prove of value in the perplexing class in which efforts have already been made to deliver, in which the child is still alive, and in which the obstetrician hesitates to employ the ordinary Cæsarean section on account of the risk of giving the infection access to the peritoneum. It may also be found useful in cases of threatening rupture of the uterus and in blocking of the pelvis by neoplasms of the internal generative organs. There is already a large literature on the subject of *sectio Cæsarea abdominalis inferior*, and the following articles may be named as worthy of consultation:—Pfannenstiel (*Zentralb. f. Gynäk.*, xxxii. p. 313, 1908); Baumm (*ibid.*, p. 451); Küstner (*ibid.*, p. 505); Spaeth (*ibid.*, p. 654); Hofmeier (*ibid.*, p. 937); Luchsinger (*ibid.*, p. 1081); Wiemer (*ibid.*, p. 1276); Hammerschlag (*ibid.*, p. 1600); Kahn (*ibid.*, p. 1604); Jahreiss (*ibid.*, xxxiii. p. 249, 1909); Latzko (*ibid.*, p. 275); Dobbert (*ibid.*, p. 379); Freund (*ibid.*, p. 560); Fuchs (*ibid.*, p. 730); Nürnberger (*ibid.*, p. 899); Fraipoint (*Scalpel* (Liège), lxi. p. 29, 1908-9); Sellheim (*Ann. de gynéc. et d'obstét.*, 2 s. v. p. 424, 1908); Blumreich (*Berl. klin. Wochensch.*, xlv. p. 1483, 1908); Pfannenstiel (*Journ. Amer. Med. Assoc.*, li. p. 734, 1908; *Deutsche med. Wochensch.*, xxxiv. p. 1718, 1908); Zweifel (*Brit. Med. Journ.*, ii. for 1908, p. 801); Von Franqué (*Zeitsch. f. Geburtsh. u. Gynäk.*, lxiii. p. 37, 1908-9); Sellheim (*München. med. Wochensch.*, lv. p. 2207, 1908); Nijhoff (*Nederl. Tijdschr. v. Geneesk.*, ii. for 1908, p. 1864); Klein (*Strassb. med. Ztg.*, v. p. 263, 1908); Franz (*Prakt. Ergeb. d. Geburtsh. u. Gynäk.*, i. p. 48, 1909); and Jung (*München. med. Wochensch.*, lvi. p. 841, 1909). Ballantyne has summarised the literature in the *Edinburgh Medical Journal* for September 1909.

CONCLUSIONS.—It is difficult to forecast the position which Cæsarean section in its various forms is likely to occupy in the immediate future. At present there is undoubtedly a very strong tendency to extend its employment to a wide range of cases, and, if the trans-peritoneal or extra-peritoneal method can be simplified, this range will be made still wider. For the obstetrician will then be able to include within the scope of his operating-knife infected cases and cases in which other plans of procedure have been unsuccessfully tried. Cases, also, in which rupture of the uterus is threatening may be treated more hopefully by



a method which aims at reaching the lower uterine segment extra-peritoneally. Already, however, some voices are being raised in protest, at least in deprecation of the widespread practice of Cæsarean section in Germany; and Pfannenstiel (*Journ. Amer. Med. Assoc.*, li. p. 734, 1908) asks whether it is right that all these operative procedures on the mother should be carried out merely to save a child already in danger from infected liquor amnii. "I believe," Pfannenstiel says, "that our modern attempts to save the child's life shoot beyond the mark." But this cannot be the last word in obstetrics, and with a simplification of the Frank-Sellheim operation we may hope to see babies, which are now perforated, saved alive, and their mothers' risks of recovery little if anything increased thereby.

**Caisson Disease.**—In certain occupations the workers are necessarily exposed to compressed air, and, in consequence, they not infrequently suffer from symptoms which range from trivial joint pains to rapidly fatal cyanosis and coma. These are directly due to the effects of high atmospheric pressure. The disease was formerly known as "Diver's paralysis," but, since the use of compressed-air chambers—"caissons"—has become general in subaqueous engineering, it is now generally called "Caisson Disease." A caisson is essentially a diving bell. Its lower end is open and rests on the sea- or river-bed; in its ceiling there is a sliding-door connected with an air-lock, through which the excavated material is removed, and at one side there is a second air-lock through which the workers enter and leave. Water is prevented from entering the caisson by air pumped into it from above; the surplus air escapes round its lower edge, so that ventilation is secured. When the necessary depth is reached the caisson is filled with cement and becomes the foundation for a pier or similar superstructure.

**SYMPTOMS.**—The characteristic symptoms of caisson disease appear after the worker has left the compressed-air chamber; they are produced by decompression. On entering a compressed-air chamber for the first time some unpleasant symptoms may arise. These are oppression and quickening of the heart-beat, and more especially pain in the ear from the drum being driven inwards. The membrane may rupture and hæmorrhage take place in the middle ear. Greenwood and Hill, however, who subjected themselves to pressure up to 92 lbs., found that no real sense of pressure was experienced. The only sensations they experienced were a change in the timbre of the voice, and a feeling of anæsthesia about the lips leading to inability to whistle.

While working in compressed air the men as a rule suffer no discomfort. Cases of illness occurring actually in the caisson are due to impurity of the air from imperfect supply, or because strata containing  $\text{CO}_2$  or  $\text{H}_2\text{S}$  are being pierced. Snell brought forward the theory that caisson disease was more likely to arise during the stage of decompression if the air in the caisson was foul. During the construction of Blackwall Tunnel he found that when the air supplied was 4000 cubic feet per man there were 28 cases of caisson disease in 100 days, but when 12,000 cubic feet were supplied the number of cases fell to zero. Recent work, however, has failed to substantiate Snell's theory.

The symptoms may begin during decompression, but are more frequently delayed for some little time. Muscular pains, known as "bends"



or "screws" are the most common; paresis of the legs with retention of the urine, abdominal pain, nausea and vomiting, giddiness, epistaxis, nervousness, and excitement may also occur. Paralysis generally passes off in the course of a few days; it is sometimes permanent, with signs of myelitis. A rapidly fatal case, quoted by Greenwood, runs as follows:—The patient was a diver who had remained at a depth of  $24\frac{1}{2}$  fathoms (between 4 and 5 atmospheres) for 40 minutes, and had ascended in half that time. He had no inconvenience during his sojourn in the water, nor for 8 or 9 minutes thereafter, when he suddenly complained of pain in the stomach and then collapsed. He immediately became cyanosed, his breathing was stertorous, and his lips covered with foam. He died within 15 minutes of leaving the water. On post-mortem examination the brain was engorged; many air-bubbles were present in the veins of Galen and in the choroid plexus and superficial cerebral vessels. The veins of the surface of the heart were beaded with air, while the organ felt like a bladder half full of water, and gurgled loudly when pressed upon. On incising the right ventricle air escaped with a puff. The mesenteric vessels were likewise filled with air, and the liver frothed on section.

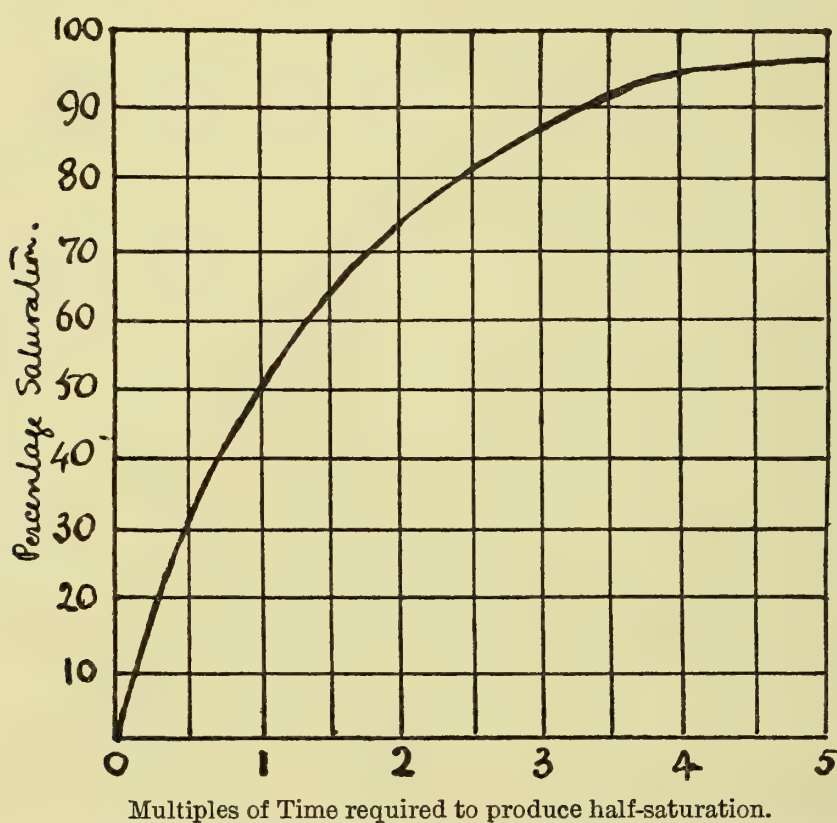


FIG. 1.—Curve showing the progress of saturation of any part of the body with nitrogen after any given sudden rise of air-pressure.—(After A. E. Boycott).

PHYSIOLOGY AND PATHOLOGY OF CAISSON DISEASE.—The effects of exposure to compressed air were first correctly interpreted by Paul Bert, and have recently been greatly elucidated by the researches of Leonard Hill, Haldane, Greenwood, and Boycott. Bert proved that—(1) increased pressure up to 7 or 8 atmospheres does not produce injurious symptoms, (2) accidents during decompression are due to the liberation of bubbles of nitrogen from the blood and tissue juices, leading to air-embolism, (3) these effects can be prevented by slow decompression.

One atmosphere equals 15 lbs. on the square inch (actually 14.7), and is practically equal to the weight of 33 feet, or  $5\frac{1}{2}$  fathoms, of water.



A pressure of “+ 30 lbs.” means 2 atmospheres above normal, or 3 atmospheres in all, or 66 feet of water. As a rule caisson workers are not exposed to higher pressure than this. Divers commonly descend to depths of 20 to 25 fathoms—120 to 150 feet, or +53 to +67 lbs. The difference between the two trades is that the former are subjected to relatively lower pressure for a longer period; the latter to higher pressure for a shorter period. The importance of this will be seen when the phenomena of saturation are discussed.

Compression, at any rate to the extent generally employed, is not dangerous; it is the process of decompression which leads to the evolution of bubbles of gas in the tissues as the body, on exposure to the lowered pressure, gives up the gases with which it has been saturated at higher pressure. The bubbles of gas occur most commonly in the pulmonary veins, causing an embolus which may be rapidly fatal; in the white matter of the cord, causing paralysis; in the fluids of the body—bile, and possibly synovia;—“bends” are supposed to be due to their production in the latter situation. The bubbles consist chiefly of nitrogen. The tissues are capable of combining with considerable excess of oxygen (up to 10 atmospheres at least); even under very high pressure the percentage of  $\text{CO}_2$  in the body remains constant, as has been shown by Hill and Greenwood, hence only nitrogen has to be considered. The composition of the air in the bubbles is—Nitrogen 82,  $\text{CO}_2$  16, Oxygen 2.

In order to understand the rationale of the prevention and treatment of caisson disease, it is necessary to realise how saturation and desaturation of the body with nitrogen occur. Under normal circumstances the tissues dissolve a given quantity of nitrogen,  $x$ . After prolonged exposure to 2 atmospheres of pressure (+15 lbs.) the quantity will be  $2x$ ; at 3 atmospheres (+30 lbs.),  $3x$ , and so on. Nitrogen is not equally soluble in all tissues; fat takes up about five times as much as blood; neither do all tissues become saturated at the same rate—those with a sluggish circulation saturate and desaturate very slowly as compared with the rest. Both these statements have practical bearings.

The blood in the pulmonary capillaries becomes saturated with nitrogen at the pressure of the air in the pulmonary alveoli, and carries this excess of nitrogen to the tissues, where it is partially desaturated, and partially saturates them. It then returns to the lungs and is again saturated. Allowing for the fact that fat can dissolve large quantities of nitrogen, the body, as a whole, can take up 35 times as much of the gas as can the total volume of blood. From this it follows, that at the end of one complete round of the circulation the tissues will have received from the blood  $\frac{1}{35}$  part of the nitrogen required to saturate them completely. But during the second round of the circulation the tissues will not receive another  $\frac{1}{35}$  of their total capacity, but only  $\frac{1}{35}$  of the difference between their actual content and their total capacity, i.e.  $\frac{1}{35}$  of  $\frac{34}{35}$ . Thus with each round of the circulation the amount taken up diminishes. In other words, the process of saturation is not steady; rapid at first, it becomes slower and slower as time goes on, for as the differences between the tissue pressure and the atmospheric pressure diminishes, the rate at which nitrogen is taken up diminishes also. The same holds good *mutatis mutandis*, as regards desaturation.

Experience shows that visitors to caissons, who are never exposed to the effects of compressed air for any great length of time, do not



suffer from caisson disease. Shifts of 8 hours are definitely more dangerous than shifts of 4 hours. In all probability the body is pretty thoroughly saturated after 5 hours' exposure to compressed air. The fact that some tissues saturate and desaturate more slowly than others is practically important. It is this property of the white matter of the cord which renders paralysis so common a result of caisson disease. The slow saturation of the fat and nerve tissues may lead to the process of saturation going on in them while the body, as a whole, is being slowly decompressed. In desaturation the body gives up its nitrogen rapidly at first; then, as the difference between the tissue pressure and atmospheric pressure becomes less, desaturation goes on more and more slowly.

DECOMPRESSION.—It has been found that caisson disease does not occur unless the pressure has exceeded one atmosphere (+15 lbs.). It may also be prevented by very slow decompression, nor does it occur if exposure to high pressure is limited to 10 minutes or so. The practical problem is, how to get the surplus nitrogen out of the body as quickly as possible, consistent with the safety of the worker. Two methods are employed, "slow decompression" and "stage decompression," and the two classes of work, diving and caisson work, have to be considered. When slow decompression is employed, Hill recommends that 20 minutes be allowed for each atmosphere. The process is necessarily tedious, because there may only be a difference of one or two pounds between the atmosphere and tissue pressures.

STAGE DECOMPRESSION.—Starting from the proposition that no symptoms are produced in man by quick decompression after an exposure of any duration to pressure not exceeding 15 lbs.—that is, a decompression of from 2 to 1 atmosphere—Boycott and Haldane conceived that, since halving the pressure always doubles the volume, it would be equally safe to decompress rapidly from 4 to 2 atmospheres, or from 6 to 3, and experiments on animals verified the correctness of their supposition. On this is founded the method of stage decompression, which is now officially adopted for divers.

"The rationale of safe, quick decompression is, then, (1) never to allow the nitrogen pressure in the tissues to be more than twice the air pressure, and (2) to make the fullest use of the permissible difference of pressure to get the nitrogen out of the tissues. Suppose, for example, that it is necessary to decompress a man saturated at +75 lbs. [90 lbs. absolute]. He can be quickly brought to +30 lbs. [45 lbs. absolute]; nitrogen diffuses out rapidly under the stress of this drop of +45 lbs., and the saturation of those of his tissues that matter falls to +65 lbs. in a time which can be approximately determined by calculation. . . . The absolute air pressure may now again be reduced to half the tissue pressure, *i.e.* to  $\frac{65+15}{2} = 40$  lbs. absolute or +25 lbs. The nitrogen-extracting stress is now only 40 lbs. at first, so that a longer wait is necessary before the tissue pressure will have fallen another 10 lbs., *i.e.* to +55 lbs. When this point is reached the air pressure is again reduced to  $\frac{55+15}{2} = 35$  lbs. absolute = +20 lbs. positive, and the stress is only 30 lbs. Hence the waits become longer and longer as the pressure falls. . . . The essential peculiarity of this method of decompression, however, lies in the fact, not that it is done *per saltus* but that it is quite quick at the beginning



and very slow at the end" (Boycott). Boycott points out that in slow decompressions there are three fallacies:—(1) No use is made of the possibility of hastening the exit of nitrogen from the tissues by putting on the greatest permissible stress. (2) However slow continuous decompression is, the difference between the tissue pressure and the atmospheric pressure becomes larger and larger (because desaturation proceeds at a diminishing rate of speed, while in slow decompression the atmospheric pressure falls steadily); hence the body may reach atmospheric pressure with a tissue pressure above +15 lbs., whereupon symptoms are likely to occur. (3) In cases of short exposure to high pressure the tissues which saturate slowly will go on taking up more nitrogen during slow decompression, and will ultimately be exposed to a dangerously rapid rate of decompression.

Greenwood agrees as to the value of stage decompression in divers; he apparently doubts whether it has any real advantage over continuous decompression at the rate of 20 minutes per atmosphere in caisson workers. All workers agree as to the importance of avoiding hurrying the later stages of the process. Particulars as to decompression will be found in the Addenda to the Diving Manual of the Royal Navy, from which the following example is taken:—

"If a diver has been working at a depth of 144 feet for between 45 minutes and 1½ hours he is directed to ascend rapidly to 50 feet and then pause for 10 minutes; he next comes to 40 feet and again waits for 10 minutes; at 30 feet he stops 20 minutes and at 20 feet 30 minutes, at 10 feet 35 minutes and then leaves the water, the whole ascent occupying 108 minutes."

For caisson work decompression can be effected by a sudden drop to half the pressure, followed by slow uniform decompression at the rate of 7 or 8 minutes for each pound of pressure. During the later stages of decompression, particularly, the workers should exercise their muscles so as to assist in the elimination of nitrogen. Fat men are ill adapted for caisson work.

When symptoms arise recompression is the only rational treatment. The diver should be sent down again; the caisson worker placed in a compression chamber.

REFERENCES.—GREENWOOD. "Arris and Gale Lectures," *Brit. Med. Journ.*, April 18 and 25, 1908.—MUMMERY. *Ibid.*, June 27, 1908.—GRANT. *Ibid.*—OLIVER. *Ibid.*, Jan. 30, 1909.—BOYCOTT. *Quarterly Journ. Med.*, April 1908.

**Cancer.**—The term cancer is used by many to designate malignant tumours arising in epithelium. It is a convenient term, which can be applied to malignant growths irrespective of the nature of their histological structure, and thus in this article it is proposed to apply the designation in the latter sense.

There is at present no disease that has been the subject of more widespread and thorough investigation than cancer. This investigation has been conducted mainly in institutions specially endowed for this purpose, and many able pathologists have been engaged upon it. As the result, there has been accumulated in recent years a large amount of material concerning the nature of cancer and its mode of growth. Most of the facts have been obtained by experimental investigation, and many of them may ultimately prove to be of great value to the clinician. It should, however, be clearly understood that from our knowledge of cancer there is at present no treatment which is to be



recommended in preference to removal of the growth by surgical operation, where that is possible. It should also be distinctly understood that, although certain therapeutic remedies have been found to influence the progress of new growths, there are none which may be used justifiably when surgical operation is possible. The treatment of cancer, according to our present knowledge of the disease, consists in the prompt removal of the growth in its entirety.

As has already been said, the facts brought out concerning cancer in recent years have been obtained mainly as the result of experimental investigation. Until comparatively recently the experimental investigation of cancer was rendered difficult, as it was found almost impossible to propagate the disease by the inoculation of it into animals of the same or different species. Some seven years ago, Jensen of Copenhagen gave a great impetus to cancer research by his discovery of a tumour which occurred in mice, and which could be propagated readily by inoculation into other mice. It is this tumour—Jensen's adeno-carcinoma—that has formed the basis of most of the experimental work done in recent years. Jensen's tumour is a subcutaneous adeno-carcinoma, homologous in every respect with carcinoma as it is met with in man, and is looked upon by virtually all pathologists as a true cancer. There are some who dissent from this view. Lazarus Barlow would describe it as an "endotheliomatous growth," and Roger Williams classifies it as a "quasi-malignant pseudo-plasm."

In his original communication in 1903, Jensen describes how the tumours which develop after the subcutaneous inoculation of a portion of the growth into mice were derived solely from the epithelial cells introduced. The tumours were created, therefore, by the cells introduced grafting on to the tissues of the new host. Jensen's tumour has now been propagated from generation to generation for five years, and it still retains its original characteristics of an adeno-carcinoma. The origin of the connective-tissue stroma of the tumour has been investigated by various workers. There is no absolute unanimity upon its source of origin. Bashford describes it as being formed from the tissues of the host. In his opinion, the stroma introduced undergoes degeneration, and is entirely replaced by supporting structures from the tissues into which it is introduced. Thus, although the epithelial cells of the tumour may be looked upon as the direct descendants of the tumour discovered originally in Copenhagen, the cells of the stroma are renewed with each succeeding generation, and arise from the tissues of the animal into which the cancer has been grafted.

Michaelis and Apolant were the first to observe in some animals the occurrence of spontaneous recovery after inoculation, a fact that was independently noted by Gaylord and Clowes, who found that in quite a large percentage of cases the tumours which formed after inoculation underwent gradual resorption and disappeared. The latter investigators also showed that mice in which spontaneous recovery had occurred could not be successfully reinoculated, and they claimed that serum obtained from the blood of such animals conferred a degree of immunity when injected into healthy mice, and furthermore, promoted resorption when introduced into animals with growing tumours. Their conclusion regarding the active immunity present in animals after spontaneous recovery has been confirmed by other investigators. With reference to their claim that they were able to get a passive immunity by the injection of an anti-cancerous serum, the same



unanimity of opinion does not exist. One of the most important facts concerning cancer as it occurs in mice is that brought out by Ehrlich and Apolant. They have been able to demonstrate that in certain circumstances a carcinoma may develop into a sarcoma. It has already been mentioned how, after five years of passage through succeeding generations of mice, Jensen's tumour retained its original characteristics as a carcinoma. Its histological characters remained unaltered. Working with tumours similar in nature but mostly of a more virulent strain, Ehrlich and Apolant found that a carcinoma might gradually develop into a sarcoma. In three tumours of different degrees of virulence, they found that, after breeding true for ten, fourteen and sixty-eight transplantations respectively, their histological characteristics became altered, and gradually assumed the structure of a sarcoma. Ehrlich's explanation of this most remarkable phenomenon is, that the injected cancer cells so stimulated the connective-tissue cells of the mouse, that they developed into sarcomatous tissue. Ehrlich succeeded in conferring a high degree of immunity to mice against virulent strains of carcinoma by injecting into them the pulp of a tumour of low virulence; the absorption of the tissue fragments producing active immunity, which persisted for a long time. This immunity was obtained in a couple of weeks, and lasted for months in from 66 per cent. to 94 per cent. of all the animals experimented upon. He also found that when a virulent mouse-carcinoma was injected into the rat, a tumour grew and then gradually underwent resorption and disappeared. These animals were thereafter found to be immune on subsequent inoculation. He also demonstrated another and most interesting fact: he found that the growing tumour in the rat could not be reinoculated into other rats, although it could be reinoculated with ease into mice. His explanation of this state of affairs is that there is present in the portion of tumour inoculated a substance necessary for its growth, and that the tumour ceases growing in the rat when this is exhausted, because the tissues of the rat do not possess this substance, and the tumour must in consequence of necessity remain sterile for all other rats. When it is reimplanted into a mouse, it can replenish from it its stock of this substance, as such is normally present in that animal. This immunity Ehrlich describes as "atreptic." The problem of immunity to cancer in mice has been studied in another aspect by Schöne. His researches were undertaken to endeavour to obtain an immunising effect with other tissues than tumour substance. He used mouse embryo, mouse liver and testis; embryo of chick and human carcinoma. He injected an emulsion of these organs into a healthy mouse, repeating the injection for from four to eight times, over a period varying from fifty to eighty days, and then inoculated the animal with mouse carcinoma. He found that an immunity against epithelial mouse tumour can be obtained by the repeated injection of pulp derived from mouse embryos. The other tissues used showed no constant effect in the direction of immunity. This, however, might be due to the blood introduced, for that, as Bashford had previously shown, can, like embryo pulp, produce a certain degree of immunity.

Dr. Bashford and his colleagues of the Imperial Cancer Research Laboratories have recently investigated certain problems in connection with carcinoma, as it occurs in mice. They have found that when mice were injected with normal tissue, immunity was conferred when the tissue injected was similar to that from which the neoplasm arose.



Other organs, whether used collectively or individually, were devoid of this power. They were thus able to induce a nearly absolute degree of protection against squamous-celled carcinoma, by injecting macerated skin. By heating the skin previous to inoculating it, instead of protection being obtained, a condition was set up which favoured the growth of the tumour.

The question of malignancy has recently been experimentally investigated by Apolant, and the conclusions he derives from his work are of interest and considerable consequence. Prior to embarking upon his investigations, he held the view that the degree of apparent malignancy of a tumour was a question entirely of its rate of growth, and that the progressive apparent increase of malignancy was due to a progressively increasing rate of growth with each succeeding inoculation. He now holds that "the type of structure of the tumour is dependent upon biological changes in the organism of the animal host." He found experimentally that in one tumour which had for fifty generations reproduced a solid reticulated type of carcinoma, that it assumed an innocent adenomatous type in such animals as had been previously treated by the immunising methods of Ehrlich and Bashford, which, of course, does not in every case prevent the tumour's development. He found that in the cases where he commenced the immunising injections just after the inoculation of the tumour, this developed with a structure of the usual malignant type. When the animals were inoculated at a later period, however, or when secondary nodules developed, these were found to have the structure of the innocent adenomatous type. His work shows an exact counterpart of the development of malignant characteristics in a previously innocent tumour due to loss of tissue resistance, and it demonstrates clearly how, by immunising methods the loss of tissue resistance may be restored, and a malignant tumour become an innocent one.

Cathcart has published a study of tumour growth, maintaining the essential similarity of innocent and malignant tumours, and showing how gradual transition-stages from one to the other are met with.

It will be seen from the record of the afore-described investigations that, although many results of great interest have been obtained, no discoveries have been made which have a direct therapeutic application. At the same time, it cannot be denied that a great advance in our knowledge of cancer has recently occurred. Although only obtained experimentally in laboratory mice, it is a fact of profound significance that animals have been immunised against cancer growth, that the type of growth has been altered from malignant to innocent, and that spontaneous disappearance of cancer can be induced with fairly regular constancy in animals in which tumours have become well established.

The etiology of cancer is still obscure. Most of the investigators whose work has been already referred to would seek to explain the origin of cancer in some perverted bodily metabolism. There are many able investigators who, on the other hand, maintain that tumours arise by the operation of a living virus introduced from without. Ford Robertson has done much work at this subject, and by investigating the histological features of carcinomatous tumours, revealed by an improved ammonio-silver method of staining, claims to have obtained a considerable amount of additional evidence of the occurrence of intra-cellular parasites in human carcinoma. The experimental evidence of the infective origin of carcinoma has been investigated further. He



experimented with mice, and injected into their abdominal wall a fluid which had been obtained from the peritoneal cavity of a case of malignant peritonitis following cancer, and which had been incubated at 37° C. for two months. The result of the experiments was negative. Other mice were given the same fluid in their food, with a similar negative result. Thirty mice were similarly fed on one occasion with fluid from the pleural cavity of a case of malignant pleurisy. This fluid had been incubated at 37° C. for seven weeks. On the following day they were given fluid from a case of malignant peritonitis, which had been incubated for nine weeks. In the course of the succeeding five to fourteen months, seven of these mice developed carcinomatous tumours, viz. three of the mamma, two of the lung, one of the testicle, and one of the uterus. These tumours possessed the structure and characteristics of true carcinoma. Ford Robertson's results are undoubtedly of interest, for although it is not denied that carcinoma may arise spontaneously in mice, the number of animals in which tumours developed is vastly greater than is found when they arise sporadically. The prolonged incubation period to which the malignant fluid was subjected has the effect, according to Ford Robertson, of enabling the intra-cellular parasite to reach that stage in its cycle, at which it is capable of propagating the disease to another species.

There has been recently published for private circulation a pamphlet by C. E. Green, in which there is described a theory regarding the origin of cancer which is worthy of careful consideration. The author divides his work up into two parts. The first is concerned with parasitic tumours as they occur in the vegetable kingdom, especially with that disease which occurs in turnips, and is known as "*plasmodiophora brassicae*," or "finger-and-toe disease." The latter portion of his work is concerned with a careful analysis of the statistical returns of the mortality from cancer in various trades and professions, and an investigation of the factors possessed in common by these where the cancer mortality is high. Although at first it might appear that there was little in common between the various occupations having a high mortality from cancer, Green shows that they have this one factor in common, that they are occupations where imperfect oxygenation of the tissues takes place. The point of his argument is that a fungoid organism cannot grow in a freely oxidised medium, and sulphuric and sulphurous acid are powerful de-oxidising agents. In the case of *plasmodiophora brassicae*, it is found that it is a disease that is started and fostered by manures which have been dissolved in sulphurous acid. In the case of those trades and professions in which the cancer mortality is high, Green has been able to show also that in many of them there is exposure to sulphurous or sulphuric acid.

Doyen described an organism which he called the *micrococcus neoformans*, and which he claimed to be the causal parasite in the production of carcinoma. The organism can undoubtedly be found in many new growths, but it is looked upon by all pathologists as a mere casual concomitant. Wright has recently published, however, an account of a case of inoperable cancer of the larynx treated by him by the subcutaneous injection of a vaccine prepared from the *micrococcus neoformans*. The treatment is claimed to have produced some beneficial results; the patient, however, ultimately died of the malignant growth.

CANCER FOLLOWING EXPOSURE TO RÖNTGEN RAYS.—It is unfortunately now only too clearly proved that prolonged exposure to



X-rays may, under certain circumstances, lead to the development of cancer. There are now on record a number of cases where this has occurred, and ultimately proved fatal. Porter and White have collected eleven cases of an undoubted X-ray cancer, and six of these proved fatal. In the case which Porter had the care of himself, he found this interesting result, that where he skin-grafted for the intractable ulceration which precedes the epitheliomatous change, the majority of the grafts adhered, they never broke down afterwards, and epitheliomata did not develop in them. He recommended accordingly that early excision be practised in cases of persistent X-ray ulceration, to avoid the development of malignant characteristics in them. Now that certain of the properties of X-rays are more clearly understood, the risk of the occurrence of this disaster are not great. It is recognised that it was especially in those who were exposed to the double irritant of the X-rays and the chemicals used in afterwards developing the plates that cancer occurred.

As a contribution to the etiology of cancer, Lazarus Barlow has carried out a line of investigation starting from the assumption that workers exposed to X-rays are liable to become affected with true squamous-celled carcinoma. He examined electrically and photographically a variety of substances which are commonly looked upon as predisposing to cancer by the irritation their presence produces. He endeavoured to find out whether these irritants shared with the X-rays any factor in common. He found such substances as paraffin, soot, gall-stone, clay pipes, etc., did not fall exactly under the category of recognised radio-active substances. It was not common radio-activity which was responsible for their share of the accusation of predisposing under certain circumstances to the production of cancer.

As has already been said, no treatment has so far been discovered to replace the surgeon's knife, where the use of such is practicable.

Every year witnesses the arrival of a new method of treating cancer. The popularity of these usually varies directly with the extent to which they are advertised in the lay press. The pancreatic ferment, as originally suggested by Beard and Mackenzie, is still being used occasionally to treat cases of inoperable cancer. The results obtained do not warrant the assumption that this form of treatment is ever likely to be widely adopted. It is a treatment which is based on the assumption that cancerous growths arise from a wandering germ cell which has settled in some situation other than the germinal ridge. After having lain dormant for a varying period, it is excited to active division by any of the irritants which are generally recognised as predisposing to the production of cancer. By its growth it gives rise to a tumour which, although simulating in structure the tissue in which it is developed, is really, according to Beard, of the nature of aberrant trophoblast. The normal trophoblast is recognised to behave at first in the manner in which it invades the maternal tissue very like a cancer. Very soon comes a period, however, when this active invasion ceases. According to Beard, this stage of arrest of the active invasion by the trophoblast is coincident with the appearance of the pancreas as a functioning gland. He thus considers that the scientific method of treating a malignant growth, a structure which, as has been said, consists of nothing else than aberrant trophoblast, should be the administration of the pancreatic ferment. Von Leyden and Bergell have tried the effect of various ferments on



malignant tumours. They found that the pancreatic ferment produced only a local non-selective reaction. They especially experimented with a ferment obtained from the liver, and found that this produced an increased reaction, which they claimed was selected for the cancerous tissue. Practical therapeutical application of the remedy, according to them, at present was unjustifiable. Bier, who has already used injection of blood as a treatment for non-union, or the delayed union of fractures, claims to have obtained benefit from injecting pig's blood into cancerous growths. When injected into a healthy individual, these substances produced an inflammatory reaction, but no destructive effect on the healthy tissue. When, on the other hand, it is injected into a cancerous mass, it produces, according to Bier, marked improvement by inducing a pronounced reaction, the pathological tissue being destroyed to a great extent, and a dry necrosis occurring in some cases.

**Carcinoma Cutis.**—In the treatment of carcinoma of the skin, free removal with a wide margin of healthy tissue is still the method of choice where the disease is on a covered part; but not infrequently the patient objects to the use of the knife and some other method is advisable. Caustics are preferable to the knife in some cases. There is no doubt that the zone of reaction around a cauterised area is beneficial, blocking up the lymphatics and tending to prevent a spread of the disease; whereas when the knife is used the lymphatics are cut across and left exposed to infection by any traces of the growth which may be left behind. Arsenious acid paste (50 per cent.), which is the one usually used, is a good caustic, but exceedingly painful. A less painful application is that of Wallace Brown who uses two pastes, the one consisting of a saturated solution of caustic potash with sufficient hydrastis canadensis to produce a thick paste, and the other of a similar paste with a saturated solution of zinc chloride. These two pastes are applied for one to five hours according to the size of the growth to be destroyed, the caustic soda on one day and the zinc chloride on the next. After one application of each a slough is produced. A dressing of some soothing powder is applied till the slough separates, and if any disease is left the pastes are reapplied as before to the diseased area. These methods by caustics are especially useful in carcinomata arising in old scars and in lupus carcinoma. In such cases the knife cannot readily be used, as there would be difficulty in getting the edges of the scar tissue together, and therefore caustics are to be preferred. There is no great risk of causing metastasis of the disease by the irritation of caustics in such cases, as the scar is not rich in lymphatics, and local spread does not readily occur.

We are now in a position to state fairly accurately in which cases X-rays will be found beneficial in skin cancers. All are agreed that X-rays are of much less value in the rapidly-growing malignant epitheliomata than in the more slowly-growing rodent-ulcers. Some prefer to give frequent small doses of the rays, others large doses at longer intervals, but it does not matter which method is used so long as sufficient rays are given, and the case is a suitable one for X-ray treatment. The X-ray method is the one to be preferred when the patient refuses operation, or the cosmetic result is important, and where there is no deep infection. All cutaneous cancers can be cured by X-rays except those of large extent and rapid growth. Large carcinomata are best treated by removal of the greater part of the growth by the knife



or caustics, and then X-rays subsequently. It has been shown by Darier that X-rays do not produce any effect on the epithelial tissue deeper than 1 cm. from the surface. Therefore, whenever possible, as much of the growth as possible should first be removed, and then X-rays applied to destroy any traces which may be left. For rodent ulcers which are still under the size of a five-shilling-piece a good method is to scrape away the hard raised edge by a sharp spoon and apply to the raw surface a chromic acid bead which has been obtained by the crystals of chromic acid on to the end of a probe in the flame of a spirit-lamp. After the scab which forms falls off, the X-rays are applied, and as a rule a rapid cure effected.

Radium has also been used successfully in the treatment of rodent ulcers, and will cure some cases which are not benefited by X-rays (see RADIUM).

The Finsen-light treatment may also be applied in the treatment of rodent ulcer, but its usefulness cannot compare with X-rays. It will cure small rodents which have not ulcerated, and also the warty growth which so often is the first sign of a commencing rodent. Morris recommends its use in larger rodents to soften the edge and reduce the number of subsequent X-ray exposures.

REFERENCES.—WALLACE BROWN. *Med. Rec.*, 18th May 1907.—MORRIS and DORE. *Light and X-Ray Treatment of Skin Diseases*, 1907.—WETTERER. *Handbuch der Röntgentherapie*, 1908.—DARIER and Others. *La revue pratique des maladies cutanées, syph. et vener.*, March 1906.

**Cataphoresis.**—The introduction of drugs through the unbroken skin by the agency of a galvanic current has recently been revived as a method of treatment under the names of cataphoresis, electrolysis, or ionic medication. Only medicaments which act as electrolytes—*i.e.* break up into ions—can be so introduced, *e.g.* aqueous solutions of salts, acids, and bases. Chloroform, alcohol, sugars, etc., are not ionisable, and cannot be used. In a solution of common salt, for example, the particles of sodium chloride are more or less dissociated into sodium ions and chlorine ions. The sodium ions are positively charged with electricity (=kations), while the chlorine ions are negatively charged (=anions). It is by the bodily movement of these ions that an electric current passes through an electrolyte; the kations flow towards the kathode, the anions towards the anode. The human body is an electrolyte; if it be connected with the poles of a battery through the agency of an electrolytic solution such as sodium chloride, the sodium ions will move from the anode into the body—towards the kathode, while the chlorine ions will move in the reverse direction. Kations are constituted by metallic radicles—K, Na, Fe, H, alkaloids, etc.; anions are constituted by acid radicles—Cl, SO<sub>4</sub>, OH, etc. The main pharmacological action of most salts is due to one or other ion—thus in potassium iodide the anion, in strychnine sulphate the kation, is active. It is therefore necessary to select either the anode or the kathode according as it is desired to introduce a kation or an anion. It has been shown by Le Duc (who has done much to popularise ionic medication) that if two rabbits be connected by a pad of wet lint, and if electrodes moistened with strychnine sulphate be applied to each, the rabbit connected with the anode is poisoned (kation) while the other escapes. Conversely, if potassium cyanide replace strychnine, the animal at the kathode is killed by the poisonous anion.



The method of employing cataphoresis is as follows:—The active electrode is covered with ten or twelve thicknesses of lint soaked in the electrolyte, and is kept firmly applied to the skin in order that the current may pass uniformly through it. The indifferent electrode is connected with a basin of salt solution in which the patient places his hand. The active electrolyte is placed over the part it is desired to treat; its size is governed by the size of the ulcer, fistula, joint, etc. The object of using so many thicknesses of lint is to prevent burning of the skin, which is apt to occur when electrodes covered only with a thin piece of chamois-leather or the like, are used. The current is gradually raised to as much as the patient can bear (40-60 ma.), and this is kept up for half an hour, then slowly reduced to zero. Turner gives the following list of maladies in which ionic medication has been used with more or less success:—Rodent ulcer, sinuses and fistulæ, strictures, fibrous adhesions, tic douloureux, neuralgia, sciatica, rheumatism, gouty conditions. Especially good results have been obtained in rodent ulcer from the introduction of zinc ions. A 5 per cent. solution of zinc sulphate is used at the anode, applied on lint over the ulcer. Chronic ulcers, fistulæ, etc., are treated in the same way. Copper ions have been used in sycosis, Cl ions in all forms of chronic fibroid change—*e.g.* Dupuytren's contraction, stricture, and even sclerosis of the cord. Salicylic ions have been used in rheumatic affections, lithium ions in gout, iodine ions in chronic pleuritic thickening. The method of cataphoresis has obviously many possibilities.

REFERENCES.—LE DUC. *Brit. Med. Journ.*, 4th Sept. 1907.—DAWSON TURNER. *Ibid.*, 4th April 1908; *Edin. Med. Journ.*, April 1908.

### **Cerebellum, Symptomatology of Tumours of.**

(See also *Encyclopædia Medica*, Vol. II. p. 191).—This subject has been exhaustively studied by Grainger Stewart and Holmes, whose paper is based on an analysis of forty cases. Their series is divided into intra-cerebellar and extra-cerebellar (cerebello-pontine angle) tumours.

VERTIGO.—When definite vertigo is present (indefinite giddiness is of no localising value) it consists either (*a*) of a sensation of the rotation of external objects, or (*b*) of a sensation of self-rotation. In (*a*) objects appear to move in front of the patient from the side of the lesion to the sound side. In (*b*) the movement is from the lesion to the sound side in cases of intra-cerebellar tumour; from the healthy to the diseased side in extra-cerebellar tumour.

DEAFNESS.—Some homolateral deafness always accompanies extra-cerebellar tumour; it is rare in intra-cerebellar tumour.

OCULAR SYMPTOMS.—Nystagmus is invariable in both classes of tumour. Typically, it is a slow, jerking movement towards the side of the lesion on looking in that direction.

MOTOR SYMPTOMS.—*Homolateral hemiparesis* is one of the most definite symptoms of unilateral cerebellar tumour. It is an atonic paresis, and is not accompanied by organic rigidity. The limbs are hypotonic, assume unusual positions during rest, and the muscles are flabby. Hypotonicity is best marked in early cases of acute onset, or when the cerebellum has been considerably damaged at operation. The hypotonicity is not associated with any constant change in the reflexes. *Cerebellar ataxy* differs from that of tabes in being due to a lack of accurate co-operation and association of individual muscular contractions, not to impairment of the muscular sense and sense of position.



It is not increased when the patient shuts his eyes. Ataxia appears only with active movement, and does not increase towards the completion of an act. In lesions of one lobe the inco-ordination is homolateral (though the other side may be slightly affected); in lesions of the vermis the inco-ordination is bilateral, or more pronounced on one or other side as the effect of the tumour varies.

DIADOCOCINESIA.—A phenomenon described by Babinski as pathognomonic of cerebellar tumour, consisting of an inability to perform accurately and rapidly alternate movements — *e.g.* pronation and supination—is common, but is not, Stewart and Holmes think, either pathognomonic of cerebellar tumour, or constant.

HOMOLATERAL TREMOR is frequent in extra-cerebellar tumour; absent in cerebellar tumour.

GAIT.—There is a tendency (*a*) to stumble towards the lesion, and (*b*) to deviate from a straight path towards the lesion. Patients correct the latter by rotating the body so that the homolateral shoulder is in advance of the other. On days when the gait is improved they may over-correct this tendency to homolateral deviation, or deviate to the opposite side.

REFLEXES.—The knee-jerks vary much. In intra-cerebellar tumour they are usually diminished on the side of the lesion; in extra-cerebellar tumour, the reverse.

DIAGNOSIS BETWEEN CEREBELLAR AND EXTRA-CEREBELLAR TUMOURS.—In cerebellar tumour the cardinal symptoms—headache, vomiting, and optic neuritis—appear early; in extra-cerebellar tumours, late. In intra-cerebellar tumours there is less implication of the 6th, 7th, and 8th cranial nerves than in extra-cerebellar tumours. The characters of the vertigo (*v. supra*) are also of assistance. In cerebellar tumour homolateral paresis is more marked than in extra-cerebellar tumour. Tremor is present in many cases of extra-cerebellar tumour, absent in cerebellar tumour. Crossed hemiplegia is highly suggestive of extra-cerebellar tumour compressing the pons. An extensor plantar response absolutely excludes uncomplicated cerebellar disease. (T. Grainger Stewart and Gordon Holmes, *Brain*, vol. xxvii. pp. 522-591.)

**Cerebro - Spinal Meningitis, Epidemic.**—After having been unknown in this country for many years, cerebro-spinal fever revisited it in 1906, and during the winter of 1906-1907 the disease occurred in an epidemic form. Belfast, Glasgow, and Edinburgh suffered most, though scarcely any considerable area throughout the country was quite exempt. With the summer of 1907 the virulence of the epidemic declined, though the disease still lingers on, cases occurring especially during the colder months. The recrudescence of cerebro-spinal fever has only been a part of a rather general prevalence of the disease throughout the western world. In 1904 it appeared in epidemic form in New York and various other parts of the United States, and about the same time epidemics were reported from Germany, chiefly from Silesia and Galicia; thence it has spread in various directions over the continent of Europe, and has naturally engaged the attention of many bacteriologists, clinicians, and sanitarians.

To the description of the clinical features of the disease as described in the *Encyclopædia Medica* (Vol. VII. p. 493), there is little or nothing to add. The type of the disease varies in no respect from the classical picture. Diagnosis has been rendered more sure by the introduction of lumbar



puncture and the universal recognition of the specific organism, which in most instances can be easily and certainly detected in the cerebro-spinal fluid.

The chief new facts which have been brought to light concerning epidemic meningitis since the present epidemic set in, may be discussed under the heads of—(a) bacteriology; (b) mode of infection; (c) relation of epidemic to posterior basic meningitis; and (d) treatment. In the last of these, happily, marked advance has been made.

1. BACTERIOLOGY.—An immense amount of literature has appeared on the bacteriology of the disease, and it is not proposed to enter upon technical details as to the morphology and cultural characters of the organism here. For these, original papers and special text-books must be referred to. Only some of the main points will be noticed. All observers have confirmed the specificity of the *diplococcus intracellularis meningitidis* of Weichselbaum. The organism can almost always be detected with comparative ease in the fluid withdrawn by lumbar puncture, and has also been detected in the blood, although its isolation from the blood is difficult, and not always successful. It stains readily with ordinary dyes—for clinical purposes Leishman's or Jenner's stain is convenient—and is found inside as well as outside the polynuclear leucocytes. It is usually present in the cerebro-spinal fluid from the onset of the disease, but as time goes on it disappears therefrom. It may be found as late as the fortieth day. Organisms are usually scanty in the very acute (fulminant) cases, and in very mild infections; they are, on the whole, most abundant in the moderately severe type. Though the cultural and staining reactions of the meningococcus have been carefully studied, there is not entire agreement on some details. Here it is enough to say that one of the leading matters in dispute is their reaction to Gram's stain. Meningococci are, as is generally known Gram-negative organisms, but some bacteriologists deny that this is an absolutely invariable character. Stuart M'Donald has described strains of meningococci which, Gram-negative in smears of cerebro-spinal fluid, became Gram-positive in cultures. Ritchie and others who hold strongly that the true meningococcus is always Gram-negative, believe that supposed variations are to be ascribed either to contaminations of the cultures with extraneous organisms (Gram-positive diplococci) or to differences in the technique of staining by Gram's method. The supporters of the variability of the organism hold that such an explanation is untenable, and here, at present, the matter rests. In most cases the meningococcus, and the meningococcus alone, is found on lumbar puncture and on post-mortem examination; M'Donald, however, has made the very interesting observation that in some cases it is associated with a leptothrix. For the methods by which the meningococcus is distinguished from the gonococcus and micrococcus catarrhalis special text-books must be referred to. W. T. Ritchie has lately described an incontrovertible case of gonococcal meningitis in which the accuracy of the bacteriological diagnosis was controlled by the method of complement fixation. The micrococcus catarrhalis is a common denizen of the naso-pharynx, and is a fertile source of difficulty in the detection of infection-carriers.

The opsonic and agglutinating power of the blood in meningitis has been thoroughly worked out. Normal blood serum has very little opsonic action, and no agglutinating action on the meningococcus. Serum of cases of cerebro-spinal fever, on the other hand, has a very



high opsonic index and very marked power of agglutination. An opsonic index of 40 or 50 is not uncommon. The opsonic power of the blood is developed from the second day onwards; it disappears during convalescence. Houston and Rankin found a high opsonic index and marked agglutination ("positive reaction") in 25 per cent. of cases examined between the second and fourth days of the disease, in 60 per cent. on the fifth day, and in 96 per cent. on the sixth day and after. The blood serum of patients suffering from typhoid, tuberculosis, pneumonia, or staphylococcal infection was found to have no agglutinating action whatever. It is difficult to escape supposing that the unusually high opsonic index met with in this disease is due to some extent to the clumping of the bacilli affording the phagocytes special opportunities for ingesting masses of organisms, in a way which would not be the case were agglutination less marked. Houston and Rankin, while admitting this possibility, point out that very high agglutinative power is sometimes accompanied by a lower degree of phagocytosis.

Another noteworthy fact in connection with the pathology of the disease is that the cerebro-spinal fluid of epidemic meningitis always has a low opsonic and agglutinative power. This explains why the symptoms of the disease go on unchecked despite the high opsonic and agglutinative power which the blood serum develops. Dingwall Fordyce found that, even when as much cerebro-spinal fluid as possible was withdrawn, that which replaced it (derived, of course, from the highly agglutinative and opsonic blood serum) had little or no opsonic power. As an example the following may be quoted from his observations:—"In the second case three estimations were made. At the first all the obtainable lumbar fluid was drawn off, lumbar puncture was again performed half an hour later, and a little fluid withdrawn, and three hours later more fluid was withdrawn. The index of the blood serum of the patient at the time was 20, and there was distinct clumping. Examination of the fluid first withdrawn showed an index of 0·6, of that withdrawn second, 0·8 and of that withdrawn last 0·7. It would appear, therefore, that the idea of performing frequent lumbar puncture with a view to bathing the parts in a fluid of high opsonic power is not one likely to meet with marked success."

So constant, after the fifth day, is this "positive reaction" of the blood serum that a diagnosis may be founded on it alone. The recognition of the meningococcus is, of course, preferable, as being a simpler method, and a direct, instead of an indirect diagnostic agent.

2. MODE OF INFECTION.—This may be considered under two heads—(a) Channel of entry of the organism, and (b) nature of the spread of infection from one person to another.

(a) *Channel of Entry*.—It has been proved that the meningococcus can be recovered from the naso-pharynx of most cases of cerebro-spinal meningitis, and it used to be assumed without question that it entered the cranial cavity directly from the throat. The latter point, however, is by no means so clear as the former, and there is some reason to suppose that the meningococcus may gain entry to the blood-stream and attack the nervous system from the spinal canal. M'Donald and others have drawn attention to the fact that in many autopsies the lesion is more advanced in the spinal cord than at the base of the brain. No direct spread from the naso-pharynx to the cranium has been conclusively demonstrated by post-mortem evidence. The possibility of an intestinal infection through swallowing the meningococcus



has been suggested by the observation that in cerebro-spinal fever there is often a very marked hyperæmia of the lymphatic glands and follicles of the intestine. M'Donald, however (who was one of the earliest to direct attention to this), found similar changes in a monkey infected by direct inoculation into the spinal cord, so that it may well be due to the general toxæmia. From the clinical standpoint Fowler points to the abolition of the abdominal reflex from the commencement of the disease, and to the retention of consciousness and intelligence in children until its later stages, as suggesting an earlier implication of the cord than the brain. For practical purposes, however, it is important to recollect that, by whatever path the meningococcus actually enters the central nervous system, it gains its first lodgment in the body in the naso-pharynx.

(b) *Spread of the Disease.*—In the present, as in former epidemics, it has been noticed that the incidence of the disease in a community is capricious in the extreme. Cases occur scattered all over a town; they neither select especially the poorer quarters, nor group themselves in streets or houses, as might be expected to take place were there direct infection from patient to patient. In 1906 Jehle published the results of some very interesting investigations on the mode of spread of the disease, in an epidemic occurring in two mining districts, Orlau and Neumühl. He showed that cases which occurred in rapid succession in point of time were separated from each other by such distances as to put the idea of direct contagion out of count. Children, who form a majority of the patients, cannot be carriers of the infection, for school epidemics do not occur. Jehle then looked to the adult population in his search for infection-carriers. In the districts under his supervision there were various mining villages, the inhabitants of which worked in different mines, so that in each village there were workers in several mines, and in each mine, dwellers in several villages. Children who fell victims to cerebro-spinal fever were nearly all members of families of miners who worked in one or two particular mines, while neighbouring children, whose parents worked in other mines, escaped. Other channels of inter-communication did not complicate the research. Mines, according to Jehle, being warm, damp, sunless places, favour the growth of the meningococcus. They may act as foci of infection, just as schools do with regard to measles. Miners become infected with meningococci without contracting the disease; it flourishes in their post-nasal spaces, and is disseminated by sneezing and coughing. As a class, miners are prone to catarrh; children do not expectorate and sneeze as adults do, hence even when they harbour meningococci they are not dangerous sources of infection. Further confirmation of Jehle's theory is afforded by the following facts:—At Neumühl there are two large mines, the workers in which inhabit separate villages communicating freely with one another by rail and tram. For the first four weeks of the epidemic cases occurred in only one of these villages; from 10th February onward cases cropped up in the second, and then the epidemic became general. During the first period no miner was transferred from one mine to the other; early in February, some miners left the infected mine and went to the other; ten days later the disease appeared in a hitherto uninfected village. This theory of the epidemiology of the disease, that adults chiefly transmit, and children chiefly become infected with, without transmitting, the disease, explains why, when several children in a house suffer, they are usually



attacked almost simultaneously, while in garrisons, etc., where adults are congregated together, they are attacked successively.

An investigation at Leith in 1907 led to similar conclusions. Comrie and Fraser found meningococci in the nares of 10 out of 69 contacts. Of these 69 contacts, 15 were fathers of patients, 54 were in some other relationship. Five of the infected contacts were fathers, 5 were not fathers; that is, 33 per cent. of the fathers harboured meningococci, as against 9 per cent. of the not-fathers. Of the 15 fathers 5 worked on a ship lying in Leith Docks; in the air of the engine-room meningococci were found.

The generally accepted view of the transmission of the disease may be stated thus:—The meningococcus can be discovered in the upper air passages of all cases of cerebro-spinal fever provided it is sought for early enough in the disease; it is also present in healthy contacts (bacilli-carriers).

Bacilli-carriers are probably about four times as numerous as patients (Lingelsheim); they have little tendency to contract the disease.

Susceptibility to the disease is rather limited (to children, especially); the predisposition to receive and harbour the organism is somewhat general. Commonly, but not invariably, it is associated with nasal catarrh; this predisposes to, but is not a result of, the reception of the organism. The meningococcus disappears from the naso-pharynx in a fortnight (dating from the time it is discovered) in 75 per cent., and by the end of the third week in 90 per cent., of cases.

Apparently the carriers who are most dangerous are adults whose occupation brings them in contact with numbers of children, and who, suffering from catarrh, are careless about sneezing and expectorating. Children are much less dangerous as carriers, for school epidemics do not occur.

3. RELATION OF EPIDEMIC TO POSTERIOR BASIC MENINGITIS.—While an acute case of cerebro-spinal fever is totally distinct from a typical case of posterior basic meningitis, it is impossible by reference to the clinical symptoms alone to draw a hard and fast line between the two diseases. During the Edinburgh epidemic of 1907 several cases were admitted to the wards of the Sick Children's Hospital, which in their course and symptoms were practically indistinguishable from ordinary post-basic meningitis. The most that could be said was, that they differed in some minor particular—*e.g.* herpes was relatively common, whereas it is rare in sporadic posterior basic meningitis. In its cultural and tinctorial reactions, Still's organism (to which posterior basic meningitis is due) resembles Weichselbaum's meningococcus very closely indeed. If we regard the two diseases as having an identical etiology, posterior basic meningitis would represent the sporadic (and attenuated) form of cerebro-spinal fever, and we might look upon it as the means by which the contagion is kept alive between epidemics. To this hypothesis, however, certain difficulties oppose themselves. Posterior basic meningitis is always present in large communities; epidemics are rare. Again, if they are identical, why does the type of posterior basic meningitis remain so constant? Why does it not more often assume an acute form? The only answer to these difficulties is to suppose that, for some unknown reason, the diplococcus meningitidis periodically acquires exalted virulence.

Houston and Rankin's work on the opsonic and agglutinative



reactions of meningococci throw some light on the relation of the two diseases, and prove that the diplococcus of Still and the diplococcus of Weichselbaum, though alike in most respects, are not quite identical. By comparing the reactions of meningococci from the Belfast epidemic with meningococci from London and Edinburgh post-basic cases, and of both these with London and Edinburgh epidemic cases, they found a post-basic meningococcus was only agglutinated and opsonised by the blood serum of post-basic cases, not by the blood serum of epidemic cases, while the meningococcus of epidemic cases was only agglutinated and opsonised by the blood serum of that disease, not by the blood serum of post-basic meningitis. They believe that "at least one variety of Gram-negative coccus, corresponding closely in cultural characters with the true meningococcus, is capable of producing meningitis. This coccus, for the present, may be styled the coccus of posterior basic meningitis, or of Still's disease. It differs entirely from the true meningococcus in its opsonic and agglutinative reactions." The correctness of Houston and Rankin's observations has been confirmed by other workers, and they certainly point strongly towards there being a more fundamental difference between posterior basic meningitis and cerebro-spinal fever than is implied in the adjectives "sporadic" and "epidemic."

4. TREATMENT.—This naturally divides itself into preventive and curative.

(a) *Preventive Treatment*.—The line of treatment laid down by Lingelsheim in a recent paper, officially communicated to the Prussian Government, is as follows:—Patients are less dangerous sources of infection than healthy bacilli-carriers, because on account of the dryness of their upper air passages they excrete few bacilli. The cerebro-spinal fever patient is, so to speak, the product of a widely diffused contagium, and regulations framed solely to prevent his spreading the disease have little prophylactic value. Cases should, however, be removed to hospital, and the dwellings disinfected. The meningococcus has such slight power of resisting drying that elaborate disinfection of houses is not necessary. It is more important to examine for infected contacts, especially the more remote contacts—*e.g.* visitors to the household, etc. When a case of cerebro-spinal fever develops it may almost be taken for granted that the immediate contacts will have meningococci in their throats; the chief step which can be taken to prevent the disease spreading is to identify the more remote carriers. Hence as many as possible of the visitors to the house, especially such as suffer from catarrh, should be examined. At the beginning of an epidemic such carriers should be isolated. When an epidemic has once taken firm hold it is almost impracticable to isolate carriers, because for every case of fever there are so many carriers, and it is almost useless to isolate a few. No satisfactory way of disinfecting the nose is known: pyocyanase (recommended by Jehle), sublimate, silver salts, zinc sulphate, permanganate, boric acid, and volatile oils have all proved unsatisfactory, however applied to the nose. Contacts should be isolated for three weeks, or until meningococci can no longer be found. In addition to isolation the public should be instructed as to how the disease spreads, and persons suffering from catarrh ought to exercise care in the matter of expectorating, coughing, and sneezing.

(b) *Curative*.—The recent additions to our armamentarium against the disease comprise—(1) repeated lumbar puncture, (2) the injection



of antiseptics into the spinal canal, and (3) anti-meningococcus serums.

(1) Repeated lumbar puncture is possibly beneficial, and certainly harmless. It may relieve the severity of the headache. Whether it has much curative effect is doubtful, but it should be employed if other remedies are not available.

(2) Injections of antiseptics (lysol, 1 per cent., and collargol, 5 per cent.) have been tried. Several cubic centimetres of cerebro-spinal fluid are withdrawn, and an equal quantity of the (warmed) antiseptic solution injected. A few successes have been reported, but failures have been more numerous. On post-mortem examination of patients treated with collargol, traces of the brown solution can be found at the base of the brain, showing that intra-spinal injections diffuse widely through the central nervous system.

(3) Anti-bacterial serums hold out by far the best prospect of cure. Mackenzie and Martin have tried injecting the patient's own blood serum into the spinal canal. The serum contains immune body and complement, and is also anti-bacterial. The results are said to have been encouraging. Serum of convalescent patients has also been used.

Flexner's serum (which is not yet procurable commercially) is derived from horses immunised against many strains of meningococci; the process requires four or five months. The serum acts chiefly on the vitality of the coccus, and increases its liability to phagocytosis. It is bacteriolytic, and to some extent antitoxic. Early administration is extremely important. Lumbar puncture should be performed, and as much fluid as possible withdrawn. In bad cases 30 or even 40 c.c. of serum are then injected into the spinal canal, and the dose is repeated in twelve or twenty-four hours if the temperature does not fall and the symptoms abate. In mild cases the dose is 15-20 c.c. In twenty-four hours the meningococci in the cerebro-spinal fluid are reduced in number and stain badly; the polynuclear cells also diminish. The temperature falls, and the symptoms rapidly improve in favourable cases. Very good results have been obtained with Flexner's serum by those who have been so fortunate as to have it placed at their disposal. Holt gives the following statistics of 442 collected cases treated:—The general mortality of the disease is 50 to 80 per cent.; in the series of cases treated by Flexner's serum it was 33 per cent. Eliminating patients who were moribund when the serum was first injected, the mortality was 25 per cent. In patients injected on the first day the mortality was only 14·9 per cent.; from fourth to seventh day, 22 per cent.; after seventh day, 36 per cent. The mortality among untreated patients under two is 90 per cent., of serum-treated, 46 per cent. The average duration of symptoms in serum-treated cases is eleven days; a quarter of the cases end by crisis, three-quarters by lysis. In 5 per cent. of cases relapses occur; these are usually recovered from. Relapse is most likely to occur if the temperature has not reached normal after the injection of serum, hence persistence of the fever shows that more serum is required. Dr. C. B. Ker also speaks favourably of the results of using Flexner's serum.

Ruppell's serum (Meister, Lucius, and Brüning) is an anti-bacterial serum prepared from several strains of meningococcus of high pathogenicity. Intra-peritoneal injections of 1 c.c. of a fluid culture in dilution of 1:200,000,000 is lethal to rabbits. It appears to do good in some cases, and ought to be tried. Poynton and Fowler have reported cures



in cases of posterior basic meningitis with Ruppell's serum. Of other serums, Kolle's is perhaps the best known. *Vaccines* have been tried by Dingwall Fordyce and Hector Mackenzie; their utility is doubtful.

The serum treatment of meningitis appears to promise much. Flexner's serum seems to be the most efficient; next to it probably Ruppell's. Whichever be used, it should be injected into the spinal canal. Subcutaneous injections are useless, as indeed might be expected considering that the agglutinative and opsonic power of the blood is already high in cerebro-spinal fever.

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**Cervical Ribs.**—Although cervical ribs have long been known as anatomical curiosities, the fact that in some cases they give rise to definite symptoms has escaped recognition until within the past year or two. Their morphology was fully described by Sir William Turner in 1870. More or less developed ribs are not infrequently met with in connection with the seventh cervical vertebra, and in rare instances the sixth cervical also carries ribs. The abnormality is usually bilateral. Cervical ribs may be quite rudimentary—mere elongations of the transverse process; they may be longer, fusing by their extremities with the first dorsal rib; they may form complete ribs, articulating anteriorly with the sternum. A cervical rib is sometimes long, thin, and pointed; sometimes broad and flat, like the first dorsal rib. Its direction, as well as its size, is important. If it runs directly outwards, it may give rise to considerable deformity in the neck, whereas if it curves round towards the sternum it will come into relation with the subclavian artery. If the rib be short, the subclavian artery and brachial plexus lie in front of it; if it be longer and curved it has a groove in its upper surface, and in this groove the artery lies. The artery is thus lengthened, and is rendered unduly prominent in the neck; the vein, lying below and in front of the artery, is less liable to be lifted into the neck. The brachial plexus, lying behind the artery, always crosses the rib if the artery does so; its lowest cord is most likely to suffer.

SYMPTOMS.—Apart from the deformity in the neck which may exist, the symptoms which are caused by cervical ribs are due to pressure on the vessels and nerves. Pressure symptoms are not found in every case of cervical ribs; it is estimated that they occur in from 5 to 10 per cent. of all cases. Thorburn, to whom much of our knowledge of the symptomatology of the condition is due, found that thirteen out of seventeen patients showed symptoms, but points out that this is obviously an excessive proportion, because it was generally only the existence of the symptoms which lead to a diagnosis being arrived at. The symptoms are not, as might be supposed, congenital, although the malformation is. They develop gradually, their evolution depending on the progressive growth and rigidity of the ribs. The period of greatest



growth is from the fifteenth to the twenty-fifth year, and in most cases symptoms do not manifest themselves until after the fifteenth year, though the onset may be delayed until much later—fifty in one of Thorburn's cases. Symptoms rarely occur during childhood; Keen collected only six cases in which they began before the fourteenth year. When symptoms appear for the first time in advanced life, their onset is apparently due to senile changes (rigidity) in the arteries.

Although cervical ribs are almost always bilateral, the symptoms which they produce are often limited to one side (nine out of thirteen in Thorburn's cases). The right arm is more commonly affected than the left, probably because it is more freely used. The onset of the symptoms is sometimes preceded by a strain or wrench. For some reason cervical ribs more frequently give rise to symptoms in women than in men.

AFFECTION OF THE SUBCLAVIAN ARTERY is shown by weakening of the radial pulsations, which become stronger when the arm is raised so as to remove the bend in the vessel where it crosses the rib. From the abnormally high position of the vessel, aneurism in the neck may be simulated. Thrombosis of the artery and gangrene of the finger-tips may occur. The subclavian vein is seldom compressed; œdema of the hand has, however, been observed.

AFFECTIONS OF THE NERVES is more important; neuralgia or paralysis may be caused. In neuralgic cases the pain has a characteristic distribution, corresponding with the area supplied by the first dorsal or first dorsal and eighth cervical roots. It is most marked along the ulnar border of the forearm, extending from above the elbow to the wrist or fingers. It is of a tingling character, and is associated with a sensation of coldness. Pressure above the clavicle may aggravate it.

In paralytic cases there is generally a history of antecedent neuralgia. The motor symptoms are due to irritation of, and pressure on, the brachial plexus, and differ in degree in different cases. The intrinsic muscles of the hand are partially or completely paralysed, and some or all of them are wasted; adduction and abduction of the fingers and thumb are impaired; cramps, clonic twitchings, and spasms may occur. There is often anæsthesia or hyperæsthesia of the skin of the inner aspect of the arm and the ulnar half of the hand. The paralysis involves the domain of the first dorsal or first dorsal and eighth cervical roots, and, as in other affections of the brachial plexus, dissociated disturbances of sensation may occur.

In rare instances the cervical sympathetic is involved, perhaps from pressure, perhaps, as Keen suggests, from associated syringomyelia; inequality of the pupils and palpebral fissures and unilateral sweating result. Scoliosis is a not uncommon associated symptom (twenty-two out of sixty-one cases). In some cases the association is merely accidental, in others (congenital scoliosis) the curvature is due to inequalities in the sizes of the vertebræ, or intercalated vertebræ. Torticollis may also be met with.

DIAGNOSIS.—Hitherto the true nature of these cases has frequently been overlooked, but the diagnosis is not difficult if the possibility of cervical ribs be borne in mind. Unless the rib is palpable, a diagnosis can only be made by X-rays. Sometimes, even when the rib is long, it may, from its position and angle, be hidden by a transverse process and cast no shadow. The association of vascular with nervous symptoms is of diagnostic importance, particularly the fact that the pulse becomes



stronger when the arm is raised. Cervical ribs have been mistaken for Raynaud's disease and writer's cramp; the condition has also been diagnosed as "brachial neuralgia," "symmetrical palsy of the hands," or "radicular paralysis." Thorburn states that "uniradicular paralyses due to causes other than cervical ribs are very rare, and their true pathology is unknown." According to Keen, affection of the cervical sympathetic is presumptive evidence of an associated syringomyelia.

TREATMENT.—The rib should be removed. The fact that paralysis may, and often does, supervene upon neuralgia warrants operation as soon as the condition is diagnosed. Thorburn advises a vertical incision in the posterior triangle of the neck, the vessels and nerves being displaced forwards. The suprascapular nerve must be carefully guarded from injury. After clearing the rib, it, with its periosteum, is cut through near the spine, and then drawn forwards. "If attached in front by ligaments only it comes up into the wound very readily, and can be excised with scissors, but if its anterior attachments be bony, its total removal becomes very difficult on account of its relation to the pleura. In such cases it may be cut away anteriorly with gouge forceps. In any event, the radial pulse should be watched, and enough of the anterior part of the rib should be removed to make it certain that all pressure is removed from the artery" (Thorburn). Certain definite dangers may be encountered during the operation:—(1) Paralysis (not always transient) of the brachial plexus from the stretching to which it is subjected. (2) Consecutive aneurism of the subclavian artery. (3) Injury to, or wound of, the pleura. The result of removal of the rib is very satisfactory; even wasted muscles may recover.

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Chloroma.

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CHLOROMA is a rare disease, characterised by progressive anæmia and asthenia, greenish tumour-like deposits in various parts of the body, most typically in the temporal regions and orbits, and a leukæmic condition of the blood. It is more common in males than females, usually occurs before the age of twenty, and is invariably fatal within a few weeks or months of its onset. Between 1893 and 1904 about twenty-one cases were reported, and since that date a considerable number of others have been described, without, however, adding materially to our knowledge of the disease.

CLINICAL FEATURES.—The usual symptoms of profound anæmia are present, and need not be referred to at length. Unless the greenish tumours are visible the diagnosis cannot be made from leukæmia either by physical examination or examination of the blood. In many cases the true nature of the disease has only been discovered at the autopsy. In a well-marked case, however, the aspect is very striking. The chloromatous tumours invade the orbits and temporal regions, causing bilateral proptosis and broadening of the upper part of the face; the



swellings have a distinct greenish-yellow colour, much more apparent than the green tint which is sometimes present in chlorosis, and this is quite characteristic. On post-mortem examination the chloromatous deposits are found dispersed widely throughout the organs; and they are sometimes localised in superficial parts of the body other than the cranium, so as to be visible as greenish tumours during life. Thus Schmidt records a green discoloration of the skin of the face, and Bramwell and Hitschmann nodular green tumours of the skin. In Dunlop's patient, one of the first in which a correct diagnosis during life was made, green deposits appeared on both conjunctivæ.

Among other noteworthy symptoms which have been met with in the disease are Bence Jones's albumosuria, deafness, blindness, hæmorrhages, ulceration about the mouth, enormous swelling of the gums (Bramwell), tumour-formation in the breasts, and enlargement of the spleen, liver, and glands. Chloroma, therefore, is protean in its symptoms, but, as Dock states, most of them can be referred to one of three causes:—the mechanical result of the green growths—exophthalmos, blindness, deafness; the toxic symptoms—asthenia, fever, and emaciation; and the blood symptoms—pallor, hæmorrhages, and the abnormal blood picture.

CHANGES IN THE BLOOD.—In all cases carefully examined a leukæmic condition of the blood has been found. The full picture of leukæmia, however, does not always develop. Sometimes there is at the beginning a normal, or almost normal white count, but even with this there will generally be found a relative excess of lymphocytes—*e.g.* Bramwell's case, which showed only 8000 leucocytes, with 95 per cent. of (mostly large) lymphocytes. As a rule, the blood corresponds with the picture of lymphatic leukæmia, but in several cases a myelocytic condition has been seen. Cases intermediate between the two also occur—*e.g.* Dunlop's patient, who during the early stage of the disease had a less leucocyte count (24,000), with between 70 and 80 per cent. of lymphocytes, and during the later stages a leucocyte count of 123,000, with nearly 15 per cent. of neutrophile myelocytes.

LOCALISATION OF THE CHLOROMATOUS TUMOURS.—In nearly all cases some part of the head is involved—the orbits, dura, temporal bones, especially the temporal fossa and auditory region, sphenoid, and ethmoid, are favourite sites. The vertebræ, ribs, sternum, clavicles, pelvis, and diploe of the skull are also frequently involved. New growths also occur in the viscera, especially in the kidneys, liver, glands, and spleen—indeed, scarcely any organ can be mentioned which has not been affected in one or other of the recorded cases. The marrow of the long bones has been invaded in a good many instances.

COLOUR OF CHLOROMA.—The nodules and deposits are of a very remarkable green tint, which is sometimes so brilliant as to merit the appellation grass-green. More commonly, however, the colour is more like that of greenish pus. In most cases all the tumours have shown this green colour; in a few the colour has not been universal, but some of the tumours have been red or brown. The nature of the colouring agent is not known. It is neither due to putrefaction, to the action of bacteria, nor to bile pigment. It rapidly fades on exposure to air, and cannot be preserved in any of the ordinary mounting fluids. Faded organs sometimes regain their colour when reducing agents are applied to them; in other cases peroxide of hydrogen has had a similar effect. It is supposed that the characteristic green colour may be due to blood pigment, or to the presence of highly refractile granules in the tumour



cells. Bramwell doubts whether the colour is of identical origin in all cases; he considers that in some cases of true chloroma the colour may be absent.

**PATHOLOGY.**—Histologically the new growths resemble a leukæmic lymphoma. According to Treadgold the chief distinctions are:—(1) In chloroma the infiltration of the walls of the small blood-vessels is better marked; (2) metastases are more frequent; (3) the eroding power of the cells is greater, for bone and nerve may be infiltrated and destroyed; (4) the cells are larger and possess more protoplasm. Apparently the new growths may be composed either of cells of the lymphocyte type, or granular cells. Warthin found many eosinophiles in his case; others have found neutrophile myelocytes. Meixner divides cases into "myeloid" and "lymphoid" chloroma on the basis of these findings. It is generally agreed that chloroma originates in the red marrow. It will be remembered that after puberty the red marrow is limited to the epiphyses of the long bones, the cranium, sternum, ribs, vertebræ, pelvis, etc.—precisely the sites which are most constantly involved by the tumour. Treadgold points out that where, as is often the case, a new growth is found involving diploe, periosteum, and dura mater, it is only reasonable to suppose that it arises from the red marrow. That it does not originate outside the bones is shown by Meixner's case (myeloid chloroma) in which only the skeleton was invaded by the neoplasm.

**CLASSIFICATION OF CHLOROMA.**—There is much conflict of opinion as to the nosological position of the disease. In some respects it resembles the sarcomata, in others, leukæmia. Dock links it to the leukæmias, and proposes the following scheme:—

Chloroma (Chloromatous Leukæmia)	Aleukæmic Chloroma (?)	
	Leukæmic Chloroma	
		1. Small lymphocyte type(?)
		2. Large                   "                   "
		3. Neutrophile type
		4. Eosinophile       "
		5. Atypical           "
		6. Mixed               "

Treadgold looks on the leukæmias and chloroma as very closely allied to the sarcomata. Chloromatous new growths arise from the myeloblasts of the bone marrow, and therefore the disease is more closely related to acute myelocytic leukæmia than to any other condition. He offers the following scheme to elucidate the inter-relationships of the group of diseases:—(1) Lymphosarcoma. (2) Leucoblastoma (acute lymphatic leukæmia). (3) Lymphocytoma — myelo-genous (chronic lymphatic leukæmia) and glandular (pseudo-leukæmia). (4) Myeloblastoma (acute myelocytic leukæmia and chloroma). (5) Myelocytoma (chronic myelocytic leukæmia).

Meixner, distinguishing between lymphoid and myeloid chloroma, regards both as sarcomatous: we have lymphosarcoma and chloro-lymphosarcoma and (an as yet hypothetical) myelosarcoma, and chloro-myelosarcoma.

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**Chorea.**—Poynton and Paine have isolated the diplococcus rheumaticus from the cerebro-spinal fluid of cases of fatal chorea; they have produced twitching movements and arthritis by injecting it into rabbits; they have demonstrated it in the pia and brain in chorea and in rabbits which have shown twitching movements. Dr. D. B. Lees urges that since, in the majority of cases, chorea means a brain infected with rheumatic diplococci, the treatment which cures rheumatism ought to cure chorea. Acting on this idea he gives to cases of acute chorea large and frequent doses of sodium salicylate. He states that success depends on the amount given daily, a further improvement sometimes following each increase in the dose. In treating a case of chorea (or rheumatism) with the large doses of salicylate advocated by Lees, there is a certain degree of risk of producing acid intoxication (see ACIDOSIS), and to obviate this risk the following rules must be adhered to:—(1) Enough bicarbonate of soda must be given along with the sodium salicylate to keep the urine alkaline. For this purpose it is customary to give twice as much bicarbonate as salicylate. (2) Constipation must be prevented; the bowels should act freely every day. (3) Careful watch should be kept for any symptoms of salicylate poisoning, especially for a peculiar deep inspiration resembling the “air-hunger” of diabetes. If this occurs, the salicylate should be stopped, and the bicarbonate increased.

For a child aged six to ten years Lees advises that the dose should be at first 10 grs. of salicylate with 20 grs. of bicarbonate; after two or three days the quantities should be raised to 15 grs. and 30 grs. respectively, and after another two or three days to 20 grs. and 40 grs. Ten doses are given in the twenty-four hours—two hourly by day, three hourly by night. The unpleasant symptoms occasionally caused by salicylate on adults—deafness, singing in the ears, delirium—are rare in childhood. Vomiting is sometimes troublesome, but may be overcome by intermitting the treatment for a day or two. Heart failure is due to rheumatic dilatation of the left ventricle, not to the drug, and “general depression” is usually absent.

In many cases this method of treatment yields extremely good results: the choreic movements speedily cease, and the patient puts on weight steadily. The risk of acid intoxication, which undoubtedly exists, can to a very large extent be prevented by attention to the reaction of the urine and the state of the bowels. It is, however, obvious that these large doses of salicylate can only be used with safety if the child is under constant medical supervision; “air-hunger” may develop rapidly, and unless it is at once recognised and the salicylate withdrawn, disaster may follow. In a discussion on the subject at the British Medical Association meeting of 1903, the late Dr. Ashby confessed that he was afraid of giving such large doses as Dr. Lees recommends, and thought that more moderate doses—40 to 60 grs. daily—would do as much as the large ones, with less risk. Langmead has reported a series of cases of acid intoxication from sodium salicylate. The urine of the patients contained acetone and diacetic acid (nitro-prusside test); oxybutyric acid was not examined for. The main facts are as tabulated:—



Case.	Age.	Dose of salicylate per 24 hours.	Total quantity of salicylate before acidosis developed.	Duration of treatment.	Sodium bicarbonate before onset of symptom.
1	5 years	20 grs.	1400 grs.	10 weeks	none
2	7 "	120 grs. for 6 doses, then 60 grs.	210 grs.	3 days	420 grs.
3	7 "	150 grs.	400 grs.	3 "	300 grs.
4	6 "	60 grs.	240 grs.	4 "	120 grs.
5	7 "	240 grs.	360 grs.	36 hours	480 grs.
6	10 "	60 grs.	140 grs.	4 "	none
7	4 "	20 grs.	360 grs.	5 "	none
8	8 "	160 grs.	580 grs.	5 "	none

OCULAR SYMPTOMS IN CHOREA.—Langmead describes the occurrence in some cases of chorea of the following ocular symptoms, which do not find a place in the ordinary text-book descriptions of the disease. (1) Hippus. This is often difficult to detect, because the rapid jerking movements of the eyes allow a constantly varying amount of light to fall on the retina, and in consequence the pupils perpetually alter in size. True hippus, however, can sometimes be observed. (2) The movements of accommodation are sometimes asymmetrical, particularly when the pupils are unequal, one pupil contracting to accommodation while the other remains dilated. (3) Contraction to light and accommodation unequal on the two sides. (4) Variable irregularity of the pupils, one being larger than the other at one time, and smaller at another. (5) Eccentricity of the pupils. Similar ocular changes have also been described by R. W. Philip.

SEPTICÆMIC CHOREA.—Sachs reports two fatal cases of acute chorea with endocarditis and septicæmia—staphylococcus aureus in one case and streptococcal in the other: several other cases seen in hospital and private practice are referred to. He proposes the following classification of chorea:—(1) Chorea with no evidence of any infection. (2) Rheumatic chorea. (3) Chorea gravidarum. (4) Senile chorea. (5) Septicæmic chorea.

REFERENCES.—LEES. *Brit. Med. Journ.*, Aug. 29, 1903 (with discussion).—LANGMEAD. *Ibid.*, ii. p. 820, 1907.—*Idem.* *Lancet*, Jan. 18, 1908.—SACHS. *Med. Rec.*, New York, Mar. 28, 1908.—POYNTON and PAINE. *Lancet*, Dec. 16, 1908.

Chorea Gravidarum.

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No very striking advance has been made in the past five or six years in the understanding of chorea gravidarum, and the malady still remains one of the most serious complications of the pregnant state. Still, there have been additions to our knowledge of the disease.

NATURE AND DIAGNOSIS.—Just as with eclampsia, so with chorea, there have been attempts to differentiate between the cases which may be called true chorea gravidarum and those in which a large hysterical or purely neurotic element is present. Whilst most of the patients are no doubt suffering from ordinary chorea (Sydenham's chorea), modified by the metabolic and other changes of pregnancy, there are some in



whom the morbid state is really hysteria (L. Launay, *Thèse de Paris*, 1901), and there are others in whom hysterical symptoms (ovarian hyperæsthesia, tenderness of the spine, and globus hystericus) are combined with the choreic phenomena.

ETIOLOGY.—Many of the patients have had chorea at an earlier age (*e.g.* in the fatal case reported by Ballantyne, *Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 182, 1909), and in them the malady commonly recurs in the first half of pregnancy; other cases are due to shock, injury, or emotional disturbance, and then the onset of the choreic symptoms is commonly later in gestation (Hirschl, *Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 56, 1903). Rheumatism no doubt plays a part in the causation of chorea gravidarum; but there is a growing tendency to ascribe considerable etiological importance to the special conditions present in pregnancy, to the tendency to auto-intoxication due to poisonous matters retained in the maternal organism and produced by the mother's tissues or those of the foetus, or by both, to the diminished power of emotional control then present (Wall and Andrews, *Journ. Obstet. and Gynæc. Brit. Emp.*, iii. p. 541, 1903), and to the worry and mental suffering due to the patient's state being undesired by her or altogether illegitimate. The toxæmic theory of the origin of chorea gravidarum would seem to be gaining considerable ground (Fletcher Shaw, *Journ. Obstet. and Gynæc. Brit. Emp.*, xi. p. 289, 1907), and it is supported by the proclivity of primi-gravidæ to the malady; the toxin is probably very similar in nature to that causing acute rheumatism, and it probably acts by making the nervous system irritable and unstable, and so bringing it back to the state in which it was in childhood (the other period in life which shares with pregnancy the tendency to the development of chorea).

PROGNOSIS.—Chorea gravidarum is a very grave complication, and as yet it cannot be said that new plans of treatment have materially altered its dangerous character. It is true that it is very rare for it to recur in successive pregnancies, although Martin (*Deutsche med. Wochensch.*, xxxii. p. 1265, 1906) has seen two such cases, and H. K. Wallace (*Brit. Med. Journ.*, i. for 1906, p. 260) one; but the explanation of this fact may be that the pregnant women who are specially susceptible to its attacks are carried off by it in their first pregnancies. It is difficult to determine the effect which the artificial interruption of pregnancy has upon the prognosis; but Wall and Andrews (*loc. cit.*) think it is not good enough to make the procedure desirable. Spontaneous abortion apparently is not to be looked for: for the proportion of women with chorea who abort is only 5 per cent., while in normal (*sic*) pregnancies it is 16 per cent.

TREATMENT.—The adoption by many of the toxæmic theory of origin for chorea gravidarum has led to a change in the line of treatment employed, although it must be said that the introduction of the new methods is taking place very slowly. In 1903 Wall and Andrews (*loc. cit.*), from their exhaustive analysis of the cases occurring at the London Hospital, were inclined to recommend good nursing and full feeding (especially with carbohydrates), with chloral hydrate or chloralamide (in small doses not frequently repeated) as hypnotics. They condemned treatment by the bromides, and thought the induction of abortion undesirable, although they admitted that the more rigorous antisepsis now in use might diminish the risks of this operative interference. Opium, they thought, was unsuitable, and alcohol to be preferred to arsenic. Martin (*loc. cit.*), on the other hand, thought well of the



bromides, and gave the bromides of sodium and ammonium in doses of 2 grams, and bromide of magnesium in doses of 4 grams (60 grains); iron and arsenic were useful in mild cases; but he did not recommend morphine or chloral. He thought that if the life of the mother were seriously threatened induction of abortion or premature labour should be carried out; but if the chorea supervened in the later stages of pregnancy he did not think induction should be quickly adopted. If immediate emptying of the uterus be desirable Martin thought it was best done by colpohysterotomy.

The influence upon treatment of the new views regarding the etiology of chorea gravidarum is seen in the suggestion by Fletcher Shaw (*Journ. Obstet. and Gynec. Brit. Emp.*, xi. p. 300, 1907; xiii. p. 347, 1908), Rudaux, and others that eliminative methods be adopted. Choreia is thus brought into the same category as eclampsia and hyperemesis. Thyroid extract has been tried for this purpose, but Shaw could not feel certain of its results. The treatment recommended was rest in bed, with a diet restricted entirely to milk, till the choreic movements showed signs of lessening, with a return to milk if they again increased; the skin and kidneys were kept acting freely by a saline diaphoretic and diuretic mixture, and the bowels were regularly opened with calomel or jalap; enemata of saline solution were to be given in serious cases. No hypnotics were recommended, and the induction of labour was regarded as strongly contra-indicated. Of course this plan of treatment is revolutionary as regards the management of chorea gravidarum; but its good effect is borne out by Shaw's statistics, and, if the toxæmic theory of the malady be the right one, the eliminative method of dealing with it is, at any rate, theoretically correct. The next quinquennium will show whether it has answered expectations.

**Convulsions in Infancy.**—Dr. John Thomson has drawn attention to the occurrence of a group of cases which may conveniently be termed “idiopathic convulsions,” because no organic or peripheral cause can be found to account for them. Their special features are:— (1) Appearance very early in life, often during the first few weeks. (2) The fits are at first short, not very severe, but fairly numerous—two or three in the day. (3) If untreated, or inefficiently treated, they soon increase in frequency, and as many as twenty or thirty may occur in the day. (4) This state of matters may last for weeks. (5) A condition of drowsiness or stupor may remain after the fits have ceased, but permanent mental impairment does not occur. The best treatment is to get the baby thoroughly under the influence of chloral. Bromide is of little or no use. Chloral hydrate should be given in doses of from 1 to 2 grs. every two hours, the object being to keep the baby constantly asleep. By regulating the dosage it is easy to keep the baby so drowsy that the fits are checked, yet not so drowsy as to prevent him swallowing. When once the baby is thoroughly under chloral the fits cease, but the drugs should be continued for thirty-six or forty-eight hours longer, and gradually withdrawn. Infants who suffer from fits of this kind are often small and puny, hence special attention should be paid to the diet. Most cases can be cured by the above line of treatment, but some die. No naked-eye lesions of the nervous system are found. The prognosis is least favourable in weakly infants. (See also SPASMOPHILE DIATHESIS.)

REFERENCE.—Thomson, *Practitioner*, Oct. 1905.



**Cryoscopy.**—By cryoscopy (Gr. *κρύος*, frost, and *σκοπεῖν*, to examine) is meant the determination of the freezing-point of a fluid. The method has chiefly been applied (in medicine) to the blood and urine, but any solution may be examined by this means, which affords a measure of the osmotic pressure. **THEORETICAL.**—According to Van't Hoff's *theory of solutions*, substances in solution behave like gases, the dissolved molecules exerting pressure on the walls of the containing vessel in their efforts to diffuse through as large a space as possible. This *osmotic pressure*, which can be measured directly by a manometer, depends (1) on the nature of the dissolved substance, (2) on the temperature, and (3) on the concentration. At the same temperature, the osmotic pressure of solutions of non-electrolytes is proportionate to the number of contained molecules, equi-molecular solutions exerting the same osmotic pressure; but in the case of electrolytes, such as salts, bases, and acids, which are partly dissociated into ions, the osmotic pressure is proportionate to the number of molecules + ions in solution. Thus a .5 per cent. solution of sugar (non-electrolyte) exerts only half the osmotic pressure of a 1 per cent. solution, but a .5 per cent. solution of sodium chloride (electrolyte) exerts more than half the pressure of a 1 per cent. solution, because in the latter case relatively more dissociation occurs in the weaker solution, and there are therefore relatively more ions than in the stronger. The similarity of the laws governing gases and solutions is shown in the following (Koranyi):—

#### *Gases.*

1. At a constant temperature the pressure is proportionate to the quantity of gas in a unit of volume.

2. At a constant volume the pressure is proportionate to the absolute temperature, irrespective of the nature of the gas.

3. At the same temperature and pressure, similar volumes of different gases contain the same number of molecules.

When a gram-molecule of any gas occupies the space of 22.35 litres, it exerts at 0° C. a pressure of 1 atmosphere.

4. The pressure of a mixture of gases equals the sum of the pressures of all.

#### *Solutions.*

1. At a constant temperature the osmotic pressure is proportionate to the quantity of matter dissolved in a unit of volume, *i.e.* to the concentration.

2. At a constant concentration the osmotic pressure is proportionate to the absolute temperature, irrespective of the nature of the dissolved substance.

3. At the same temperature and osmotic pressure solutions of different substances contain the same number of dissolved molecules in a unit of volume.

Any solution which contains one gram-molecule dissolved in 22.13 litres exerts at 0° C. the pressure of one atmosphere.

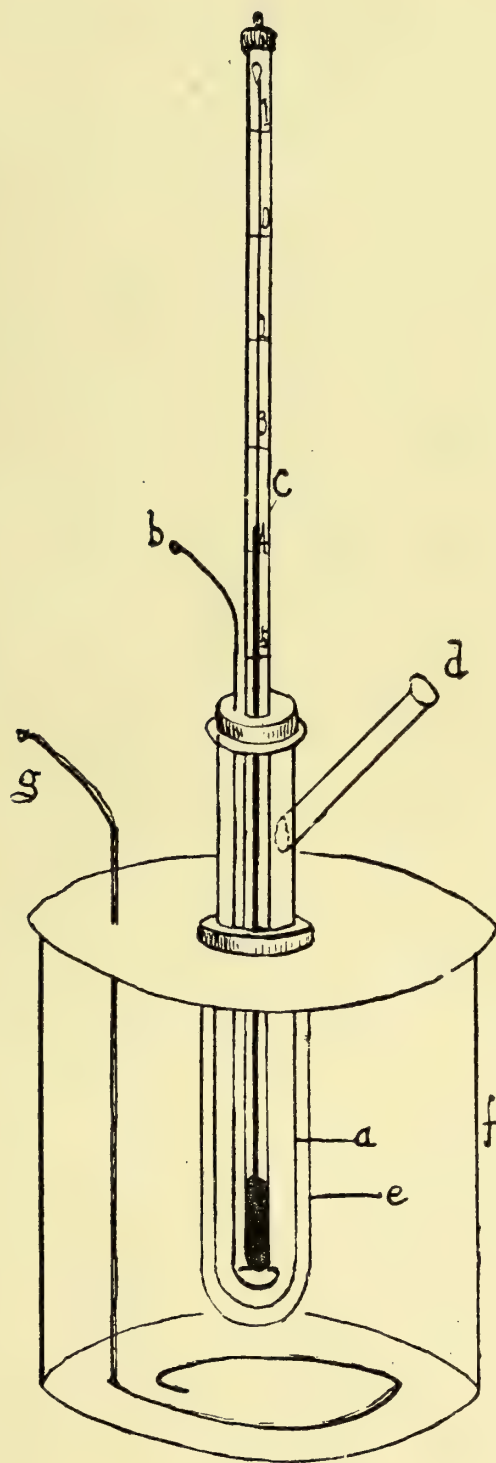
4. The osmotic pressure of a solution of different substances is the sum of the osmotic pressures of all.

The freezing-point of a solution is lowered, as compared with that of distilled water, proportionately to the number of molecules (or molecules + ions) it contains; hence from it the osmotic pressure can be estimated. Now a gram-molecule dissolved in 22.13 litres has an osmotic pressure of 1 atmosphere, hence a gram-molecule in 100 c.c. will have a pressure of 221.3 atmospheres, and it is found that this lowers the freezing-point by 18.5° C.—in other words, a lowering of the freezing-point of the



solution by  $1^{\circ}$  is equal to just about 12 atmospheres of osmotic pressure.

For practical purposes, since in medicine we are dealing with fluids containing dissociable molecules, and are concerned only with relative variations, we do not express the osmotic pressure in terms of dissolved molecules or in atmospheres, but take the freezing-point as a standard—the lower it is the greater the concentration of molecules or molecules + ions.



*Technique.*—Beckmann's cryoscope, or one of its modifications, is generally employed. It consists of a tube (*a*) which contains the fluid to be examined, and is closed by a doubly perforated cork through which a metal stirrer (*b*) and a thermometer (*c*) reading to  $\frac{1}{100}^{\circ}$  pass. The tube (*a*) has a lateral opening (*d*) and is enclosed in a second tube (*e*), the intervening air space acting as a non-conductor and preventing too rapid cooling. The whole is immersed in a larger vessel (*f*) containing freezing mixture, also provided with a stirring rod (*g*) and a cover (*h*). The thermometer employed



has a range of from  $-4^{\circ}\text{C.}$  to  $1^{\circ}\text{C.}$  or thereby; it must be carefully calibrated and requires to be standardised from time to time with pure distilled water which freezes at zero. The accuracy of its scale may be verified by a 1 per cent. solution of pure sodium chloride, which freezes at  $-589^{\circ}\text{C.}$  Any errors detected must be allowed for in subsequently using the instrument. In making an observation the outer vessel is filled with a freezing mixture, which should not be too cold,  $-3^{\circ}$  being a desirable temperature. Five or ten cc. of the fluid to be examined is now placed in the tube, which is then introduced into the freezing mixture. The fluid must be kept in gentle, constant motion during the observation. The mercury will be seen to sink steadily below the freezing-point, and then suddenly rises to a definite point at which it remains stationary. This is read off as the freezing-point. Crystals of ice begin to form, and the fluid eventually becomes solid, whereupon the thermometer falls again.

The whole manipulation is one of some delicacy, and a number of precautions, as well as a certain amount of practice, are required to ensure reliable results. The bulb of the thermometer must be completely submerged without coming in contact with the tube. In stirring the fluid splashing must be avoided. For various reasons excessive cooling vitiates the results, hence the freezing mixture should not have a temperature lower than that mentioned. Excessive cooling may also be prevented by introducing a minute crystal of ice through the tube (*d*) as soon as the temperature falls below zero; this accelerates freezing without diluting the fluid, as, of course, the ice introduced cannot melt at below  $0^{\circ}$ .

The freezing-point of human blood is extremely constant in health, lying between  $-55^{\circ}$  and  $-57^{\circ}\text{C.}$  It is customary to express this by the symbol  $\delta$ , the minus sign being omitted. The normal average freezing-point of the blood is written  $\delta\cdot56$ . To denote the freezing-point of the urine  $\Delta$  is employed.

*Cryoscopy of the blood* is chiefly of importance as a gauge of the functional activity of the kidneys. It has the disadvantage that a fairly large quantity—10 to 20 cc.—is required. In practice the osmotic pressure of the serum may be regarded as equal to that of the whole blood, hence the blood is allowed to coagulate and the serum alone is employed. A slight admixture of corpuscles is of no moment. So constant is the freezing-point in health that variations of  $\cdot01\text{--}\cdot02^{\circ}$  are pathological. Thus  $\delta = \cdot58$  or  $\cdot59$  points to retention of molecules, while in some cases of uræmia  $\delta = \cdot65$  or  $\cdot7$ . In conditions of asphyxia the value of  $\delta$  is also raised, but falls to normal as soon as the blood is properly oxygenated. Putting this aside it may be said that a rise in the value  $\delta$  is a sign of renal inadequacy, and contra-indicates surgical interference in kidney lesions.

The information which cryoscopy of the blood affords in other directions is of minor import. In pregnancy  $\delta$  has a low value, rising to normal after delivery as the osmotic pressure of the blood returns. In hydræmic conditions generally the freezing-point is high; in diabetes it is low, from concentration of the blood. It is possible that cryoscopy may yield forensic evidence of value, since in death from drowning  $\delta$  tends to approach the freezing-point of the fluid in which the body is immersed.

*Cryoscopy of the Urine.*—The chief molecules influencing the freezing-point are those which are most abundantly present, viz. urea and sodium



chloride. As dissociation of the latter takes place after the urine leaves the kidney the concentration of the urine cannot be taken as an exact measure of the osmotic energy of the organ. From the simple fact that  $\Delta$  varies widely in health, inferences must be drawn with caution, and as it is practically impossible to obtain the urine from each kidney separately for anything but a short period, it will be seen that cryoscopy of the urine cannot be of such diagnostic importance as that of the blood. Sahli, indeed, believes that it presents few advantages over the estimation of the specific gravity, and states that in a urine free from sugar and proteid  $\Delta$  may be calculated empirically by multiplying  $\cdot 075^\circ \text{C.}$  by the last two figures of the sp. gr., carried to the third decimal place. In normal adults  $\Delta$  is greater than  $\delta$ , averaging from  $1\cdot 2^\circ$  to  $2\cdot 3^\circ$  in the mixed twenty-four hours' urine. After copious draughts of water it may sink to  $\cdot 1^\circ$ , or with restricted intake of fluid rise to  $3\cdot 5^\circ$ . In breast-fed infants  $\Delta$  is usually less than  $\delta$ , varying from  $\cdot 087^\circ$  to  $\cdot 45^\circ$ . On the whole, in renal inadequacy  $\Delta$  is low, but of more importance is the fact that a damaged kidney has lost its power of responding to the demands made on it, hence alterations of the intake of water are not followed by the normal corresponding variations in  $\Delta$ . The following figures from Koranyi illustrate this:—In a case of unilateral pyonephrosis  $\Delta$  on the diseased side was  $\cdot 49^\circ$ , on the healthy side  $1\cdot 63^\circ$ . After copious drinking, values of  $\cdot 34^\circ$  and  $\cdot 08^\circ$  respectively were given. Hence the freezing-point of the urine is a test of renal efficiency only when considered in relation to the fluid ingested, and a low value of  $\Delta$  is significant only when constant over considerable periods of time. If  $Q$  = the quantity of urine excreted in twenty-four hours,  $Q\Delta$  expresses the molecular excretion, and  $Q(\Delta - \delta)$  the osmotic energy in that time. A product equivalent to  $Q\Delta$  may be obtained by multiplying the last two figures of the sp. gr. by  $2\cdot 33$ , and by the number of litres passed in twenty-four hours, which gives the approximate number of grains of solids excreted in that time (Sahli).

From the above it will be seen that while in cryoscopy of the blood we have a valuable method of estimating the activity of the kidneys, the same cannot be said of cryoscopy of the urine. In the present state of our knowledge the following general statements seem all that are warranted:— $\delta = \cdot 56$  shows that at least one kidney is adequate, and justifies surgical operation. If  $\delta = \cdot 59$  or more, nephrectomy is contra-indicated, though less serious operations—*e.g.* nephrotomy—may be performed. If  $\delta = \cdot 6$  or more, it is probably unsafe to interfere until a more normal figure has been regained. When  $\Delta$  is persistently below  $\cdot 8$  or  $\cdot 9$  it indicates renal inadequacy; the urine of each kidney should be examined separately, or other tests (phloridzin or methylene blue) employed. A comparison of  $\delta$  and  $\Delta$  should be made. Some guidance as to the efficiency of the kidney function may be gathered from the variations of  $\Delta$  under copious drinking of water and restriction of fluid.

Cryoscopy of other fluids, pathological and physiological—*e.g.* the liquor amnii and effusions—has been practised, but the results obtained, though scientifically interesting, have had as yet no practical outcome.

**Curettage.**—There has been no radical change in either the method of performing uterine curettage or in the indications for its use during the past five or six years. For a time interest was centred in the operation of vaporisation of the uterus (atmocausis), which was expected by some to take the place of curettage; and although this expectation has not been realised, it has been thought well to give a



description of this competing method of treating uterine morbid states. See ATMOCAUSIS.

Considerable discussion has taken place, more particularly in the pages of the *Zentralblatt für Gynäkologie*, regarding the explanation of the cases of curettage and sounding of the uterus in which the instrument perforates or appears to perforate the uterine wall. That there is a real danger of uterine perforation with the curette was abundantly proved during a discussion which took place in the American Gynecological Society in 1905 (*Trans. Amer. Gynec. Soc.*, xxx. p. 15, 1905), when cases were reported in which prolapse of intestine through the uterus had followed curettage. Congdon, also, has put on record (*Amer. Journ. Obstet.*, liv. p. 618, 1906) an extraordinary case in which sixteen inches of gut had been torn away during curetting; the patient came under his care, and he opened the abdomen, closed the uterine wounds, and attached ileum to cæcum by means of a Murphy button; recovery followed without pyrexia. There are other instances, however, in which there is reason to believe that the perforation of the organ by the curette is only apparent: the curette slips in suddenly as if it had passed through the wall, but after-events (*e.g.* the opening of the abdomen) show complete integrity of the uterine tissue. Various explanations have been given of these "false perforations:" it has been thought that sudden uterine relaxation (atony or loss of tone) occurs, or that the curette (or sound) passes for some distance into a Fallopian tube, or that there has been a septate condition of the uterus. Articles on the subject have appeared by W. Thorn (*Zentralb. f. Gynäk.*, xxviii. pp. 1072, 1128, 1253, 1904), by O. Schaeffer (*ibid.*, xxix. p. 1209, 1905), by Robert Asch (*ibid.*, xxix. p. 1250, 1905; xxx. p. 172, 1906), by R. Kossmann (*ibid.* xxix. p. 1529, 1905), by Catharine van Tussenbroek (*ibid.*, xxx. p. 47, 1906), by Jakob (*Diss. inaug.* (München), 1905), by Meyer (*Zentralb. f. Gynäk.*, xxx. p. 1045, 1906), by Braun-Fernwald (*ibid.*, xxxi. p. 1161, 1907), and Kuntzsch (*ibid.*, xxxi. p. 1590, 1907). Some of the cases are possibly explicable as partial perforations in which the curette has passed through the muscle without wounding the peritoneum.

**Cytodiagnosis.**—One of the most recent advances in clinical pathology consists in the histological examination of various fluids derived from the patient, whereby their cell content may be qualitatively and quantitatively estimated. Certain secretions which have been altered by disease, and inflammatory and passive exudates, are found to contain cellular elements which vary with the cause of the disease process and with the stage at which this has arrived. It has, of course, long been the custom of careful observers to search various secretions and exudates for histological evidences of new growth where the presence of this has been suspected. In pathological urines, too, the various cellular elements of the deposit have long been examined critically for purposes of diagnosis; and the localisation of lesions of the urinary tract has been assisted by recognition of the kinds of epithelial cell present, together with its reaction to certain dyes, notably alizarin blue. Again, the character of the cells present in the sputum has been microscopically investigated, with results bearing upon the nature and situation of pulmonary lesions: the presence of large numbers of eosinophile leucocytes in asthmatic sputum may be instanced. The contents of the blebs in certain bullous skin eruptions have been similarly dealt with: here also the existence of eosinophiles in relatively large numbers



in cases of true pemphigus has been noted. Lastly, most pathologists have recognised the advisability of making a cytological as well as a bacteriological examination of pus obtained from any source. All these are instances of cytodiagnosis. But the method has taken a new departure during the past few years, and various inflammatory exudates have been systematically examined with a view to differentiating, by means of their cell content, the causes of the disease. It is to this investigation particularly that the term cytodiagnosis is now applied.

In this field the chief work has been done by the French school of clinical pathologists, led by Widal, Sicard, and Ravaud. These observers have obtained results which justify them in deducing certain formulæ of considerable diagnostic and prognostic value. These formulæ are receiving daily confirmation and qualification by other investigators, including several English microscopists. The technique of the method of investigation is exceedingly simple. The fluid to be examined is collected, films are made either directly or after centrifugalisation—depending upon the richness of the material in cells and whether a quantitative examination is, or is not, needed—and these films are examined fresh and after appropriate staining. If the fluid clots readily, as in the case of most pleural effusions of inflammatory origin, the clot is broken up prior to examination. The various cells present are then noted, and a differential count is made after the manner of a white blood cell count. The cells met with are of four types. Three of these are identical with the commonest cells present in blood—the red blood corpuscle, the polymorphous leucocyte, and the lymphocyte. The fourth cell is the endothelial plate derived from the lining membrane of the particular cavity whence the fluid has been obtained. Consideration of the significance of hæmorrhagic effusions lies outside the scope of this article. The endothelial cell varies in its individual characters according to the situation investigated, but also, and to a larger extent, according to the nature of the pathological process present. Thus it is smaller and shows signs of greater activity in fluids which result from inflammations, especially when acute, than in those which result from passive exudations (transudations). But it is to the relation in numbers existing between the two forms of leucocytes that attention has been specially directed.

In the case of *pleural effusions*, and in the case of fluid removed from the *meninges* by lumbar puncture—the two investigations where the method proves to be most profitable—the following formula has been sufficiently established:—*A high lymphocyte count during the early stages of an inflammatory process indicates that the cause is a tuberculous infection; a high polymorphous count during the same stages indicates that the cause is an infection by some "pyogenic" organism—streptococcus, staphylococcus, pneumococcus, meningococcus, gonococcus, colon bacillus, etc.* The qualification as to the stage of the disease is necessary, because it has lately been shown that during the stage of convalescence from "septic" infections, or after these infections have become chronic, the polymorphous cells present in the exudate may give place to lymphocytes. It follows, therefore, that a change in nature of the cells from the polymorphous variety to the lymphocyte indicates a good prognosis so far as the stage of infection is concerned. This change is not infrequently seen when cytodiagnostic observations are made in cases of meningococcal meningitis, in which recovery, at least from the infective stage, is not uncommon. With regard to the actual percentage of the



dominant cell present no definite statement can be made; the figures, however, are usually sufficiently pronounced in the one direction to leave no difficulty in applying the formula—75 per cent., more or less, is a figure very commonly obtained. The figure may be much higher: the writer has counted a first 100 cells in the effusion from a case of primary tuberculous pleurisy, without coming across a single polymorphous cell. The occurrence of a pyogenic infection together with a tuberculous infection shows itself by the presence of a higher polymorphous count than in a tuberculous infection alone. Indeed, in actual practice, the tuberculous part of the disease in these cases is not suggested by the cytodiagnostic method. Thus, pleural effusions occurring in the course of pulmonary phthisis obey the “septic” part of the formula, as also does a terminal streptococcal meningitis in the course of a tuberculous meningitis.

In the case of *ascitic fluids* the formula is by no means so trustworthy; however, the absence of microbic infection may be inferred from the presence of passive endothelial cells and the comparative absence of polymorphous cells and lymphocytes. In the case of fluid from inflamed *joints* there is as yet no sufficient body of evidence at hand to warrant any conclusions.

It will be noticed that the formula given above deals only with *qualitative* results of cell counts. Some important indications follow the *quantitative* examination of certain fluids with regard to their cell content, and this is particularly so with the cerebro-spinal fluid. Normal cerebro-spinal fluid is free from cells, or contains an occasional lymphocyte only. A condition of lymphocytosis exists in certain diseases of the central nervous system, and appears to be proportional to the degree of meningeal involvement present. Thus, a slight lymphocytosis is found to occur in tabes dorsalis and in insular sclerosis; a somewhat higher cell count is present in general paralysis of the insane, in cerebral syphilis, and in the case of cerebral tumours involving the meninges. It may readily be seen that these facts—always to be taken in connection with the more immediately clinical aspects of the case—provide considerable assistance in differential diagnosis of nervous diseases, and form an additional reason, if this were necessary, for the more extended use of lumbar puncture as a means of clinical examination in obscure diseases of the nervous system. It need scarcely be pointed out that the cytodiagnostic method may yield valuable information in deciding between organic and functional nervous diseases.

**Dechlorination.**—See NEPHRITIS (*Treatment*).

**Deciduoma Malignum.**—See UTERUS, TUMOURS OF.

**Dementia Præcox.**—Dementia præcox is a term recently introduced by Kraepelin to include a large number of clinical types of insanity. It is the adolescent insanity of English writers, the Jugend-irresein of the Germans, the démence précoce of the French, and the primary dementia of the Americans. Kraepelin's conception of dementia præcox is generally regarded as constituting a distinct advance in psychiatry, although his views have not by any means received universal acceptance in their entirety. It is impossible to give any short, comprehensive definition of the term. Before Kraepelin's generalisation, alienists classified the primary insanities of adolescence and young



adult life in a great variety of ways—mania, melancholia, stupor, dementia, catalepsy, delusional insanity, and so on. What Kraepelin does is to subordinate all these clinical features to one which is common to all cases—namely, progressive mental deterioration. At the beginning of the chapter on dementia præcox in his text-book, he says: “Under the term dementia præcox we range a series of disease pictures whose common characteristic is a termination in a peculiar weakened state of the mind. This unfavourable outcome need not occur in every instance, but is nevertheless so exceedingly frequent as to justify our holding fast to this general name.”

Practically, Kraepelin raises the ultimate result of a disease process to the level of a nosological criterion; his presentation of dementia præcox is therefore an advance in the prognosis of a hitherto unclassified group of cases. An excellent historical sketch of the gradual evolution of the modern idea of dementia præcox is given by Dorsay Hecht (*Journ. of Nervous and Mental Diseases*, 1905), who quotes Clouston as having recognised the existence of the condition in question in 1888—“There are many cases [of adolescent insanity] where previous excitement was so slight and so short-lived that we must conclude that the essential nature of the mental disease was a tendency to dementia from the very beginning.”

Dementia præcox may begin in adolescence, or its onset may be delayed until the third or fourth decade. The variety of clinical forms included under the term is very great, and Kraepelin admits that to a superficial observer the connection between them may not be very readily discernible. A very clear account of Kraepelin's presentation of dementia præcox is given by Dr. Macpherson in the *Review of Neurology and Psychiatry*, vol. v., 1907, and the following description of the main symptoms is taken from that paper:—

(1) A peculiar stupid listlessness in which patients appear oblivious of their surroundings, but are in reality able to appreciate what is happening. Only when there is profound stupor, a grave melancholic condition, or serious delusion, are orientation and the perception of the surroundings markedly interfered with.

(2) The sensory sphere is implicated; there are dream perceptions and occasionally hallucinations, often of an unpleasant nature.

(3) Consciousness remains clear, except in the excited and stuporose conditions. Attention, however, is affected, and sustained conversation is impossible. On the other hand, it is not infrequent to see such patients observe stealthily what goes on around them, look curiously in at open doors, follow people at a distance, and manifest generally a sort of morbid curiosity in their surroundings.

(4) Memory is relatively little disturbed, except after severe stupor. Even up to the time of the occurrence of deep dementia, patients retain all they have learned at school.

(5) Mental processes undergo deterioration sooner or later. There is incoherence or repetition of (often unmeaning) words—“verbigeration.” The phenomenon known as “stereotypism”—*i.e.* the recurrent use of phrases expressive of special ideas which dominate the mind for long periods—is almost always present as a symptom of a disordered mentation.

(6) Judgment is always affected; patients are incapable of correctly comprehending their position, and are helpless when placed under new or novel conditions.



(7) Delusions are apt to arise on this basis. At first these tend to be sad; later, grandiose. Owing to the mental weakness the delusions ultimately, as a general rule, become nonsensical, and at last terminate in forgetfulness.

(8) The disposition changes. At first the patient is depressed, with outbursts of exaltation. Next follows a state of good-natured dementia, with dislike for recreation, apathy towards friends, and complete indifference towards bodily discomfort.

(9) Conduct. There is loss of initiative and neglect of work; suicidal, destructive, or self-mutilation impulses occur. The ordinary actions of life are traversed by morbid impulses, and mannerisms result.

(10) This loss of volition and the dominance of impulses leads to a state of matters called "negativism," which shows itself by an obstinate opposition to all the ordinary practices of daily life—such as going to bed, eating, going to stool, etc.

(11) The working capacity of the patients fails greatly.

(12) Kraepelin also gives the following bodily symptoms:—Epileptiform spasms, choreiform movements, increased tendon reflexes, increased mechanical irritability of muscle and nerve, dilatation of the pupils, irregular cardiac action, increase of the sweat and saliva, diffuse enlargement of the thyroid, disturbed sleep, variations in the body weight.

Dementia præcox is subdivided into three great groups, defined as follows:—

(1) *Hebephrenia* (ἡβη, puberty; φρήν, mind).—"By hebephrenia is meant all those forms of dementia præcox in which a uniform, more or less profound, condition of mental weakness is developed under the accompanying influence of subacute—more seldom of acute—mental disturbances."

(2) *Katatonía* (κατατείνω, I stretch tightly).—"Katatonía is essentially a peculiar disease process, progressing through stupor or excitement to a condition of dementia, with intercurrent symptoms of negativism, stereotypism, and auto-suggestibility in the spheres of action and work."

(3) *Dementia paranoides* (παρα, beyond; νοέω, I know).—"Dementia paranoides includes a group of cases in which delusions and hallucinations are produced in an otherwise clear mind throughout many years of a steadily advancing mental weakness."

Kraepelin admits that these distinctions are largely artificial, and that cases run into each other and overlap continually. The *hebephrenic type* begins in adolescence; heredity is a factor in 70 per cent. of cases. Three-quarters of the patients pass into dementia; of the other quarter, two-thirds recover partially, and one-third completely. *Katatonía* begins a little later (at the average age of 24—the youngest of Hecht's cases was 15, the oldest 30). Brain workers are most prone; a bad heredity is given in 45 per cent. The special features of katatonía are muscular rigidity leading to the assumption of bizarre attitudes, constrained gait, puckering of the features, etc. Stupor and excitement alternate; during the excitable stage, self-mutilation, coprophagia, and other filthy habits may be practised. Kraepelin holds that 60 per cent. of katatonics become demented, 27 per cent. practically so, and 13 per cent. recover. *Dementia paranoides* is a rapidly progressive dementia, with delusions, illusions, and hallucinations. These may lead to suicide, infanticide, fire-raising, etc. The delusions are mostly of an exalted nature, and are not coherent. The outlook is very unpromising; weak-mindedness sets in rapidly.



DIAGNOSIS.—Dementia præcox has to be differentiated from circular insanity, from paranoia, and from general paresis. Hecht lays stress on the negativism of dementia præcox as opposed to the simple inaction of circular insanity, on the absence of systematised delusion and the presence of feeble-mindedness as opposed to paranoia, and on the absence of organic signs and the retention of memory until a late stage of the disease as against general paralysis.

It would take more space than is available to mention the criticisms brought against Kraepelin's views. A summary of them is given by Hecht in the paper referred to, which also contains a large number of references to the literature of the subject.

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INTRODUCTION.—The Dermatitis Traumatica et Venenata in Coal-Miners form a very interesting study to every colliery surgeon. The difficulties attendant on such an investigation are, however, numerous. The separation of the influence of general hygienic surroundings, of poverty, of heredity, and of treatment in a more or less migratory class of workers from the direct influences exerted by the different occupations is clearly a formidable difficulty. All pit-workers do not suffer alike. Some have skins far more liable to lesions than others, so that an exciting cause in one case may have no influence in another. Again, those pitmen who are not unduly susceptible to either physical or chemical agents may show no dermatitis on the first application of an external irritant, but may do so if circumstances expose them to its influence frequently.

On the other hand, the history aids one greatly in arriving at a logical conclusion as to whether the disease is the result of occupation or not. The lesions are often quite local in their distribution and their etiology easily accounted for. Not only is this the case, but when the affection is seen only in those employed in mining, and when there is a repetition of attacks under similar circumstances, coupled with recovery when the cause is removed, one has no difficulty in stating that the disease is one due to occupation. The conclusion which one is driven to is that of the inflammations of the skin occurring in miners, and brought on by external irritants, some are due to physical and some to chemical causes.

### A. PHYSICAL CAUSES DIVISION :—

(1) *Intertrigo*.—This affection usually makes a sudden appearance between two opposed surfaces of skin. Its favourite situations are the axillæ, lower half of extensor surface of right arm and inside of lower third or lower fourth of right thigh in right-handed hewers, the left arm and left thigh in left-handed hewers, groins, scroto-femoral clefts, scrotum,



perineum, natal cleft, glans penis, and prepuce. The sensations produced are those of heat and pruritus.

The history usually given is that the skin on the opposing surfaces became chafed and now feels hot and sore. The first appearance is simply a reddened surface, which, however, soon becomes raw as well as redder. On further irritation a fluid exudation covers the surface, and the result is a scalding or maceration of the affected area or areas of skin accompanied by the production of an offensive odour. The condition may end in an eczema.

The etiology of this affection comprises a number of factors. Heat, moisture, contact, pressure, movement, and friction all play their part. In addition, coal-dust and coal-particles accumulate in the situations above mentioned, and by irritating the skin, especially when perspiration is practically dropping off the skin, cause an intertrigo. Another factor is the want of cleanliness, especially in the region of the genitals. In their daily ablutions some miners omit the latter region or only cleanse it partially. Again, the right-handed hewer who works with the back of his right elbow and the lower half of the extensor surface of his right arm against the inner surface of the lower third or lower fourth of the right thigh produces an intertrigo of the parts in contact. In no case, however, have I seen a malignant condition result such as one gets in sweeps.

The treatment which has been found to be most serviceable consists in warm local boric acid baths followed by the application of carbolic oil (1 in 30), combined with rest of the affected parts. Strips of dry boric lint should be placed in the diseased clefts after each application of carbolic oil, or they may be soaked in the oil previous to their being applied. Oxide of zinc, starch, bismuth, calamine, fuller's earth, and other powders of the same nature, or combinations of these so-called harmless powders, do far more harm than good, and greatly encourage a relapse through their tendency to cake.

(2) *Eczema of the External Auditory Meatus*.—Eczema in this region is usually of the acute vesicular type, and is to be met with in all degrees of severity. The chief cause in coal-miners is the irritation produced by the presence of coal-dust and stone-particles which gain access to the external auditory meatus while the hewer is working, as he often has to do, with his head abducted. A right-handed hewer would thus have the left ear affected, a left-handed hewer the right ear. The sharp and angular particles of stone are more apt to cause irritation than the particles of coal. If the cerumen is abundant, the particles become entangled in it, and the two ultimately form a plug of impacted cerumen. When removed, they are seen to be usually tubular, and they vary in length from  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch. Such a condition causes an impairment of hearing, and gives encouragement from its recurrence to an attack of eczema. In some of the occupations in the pits the danger to life is increased by an auditory apparatus in bad working order, and hence pitmen soon consult a medical man if there be any sign of deafness. Should the eczema cause a narrowing or tortuosity of the canal throughout its whole extent, it may necessitate the pitman's changing his occupation.

Painting the affected region with friar's balsam seems to fail in curing this troublesome affection. To soften the plug thick castor oil should be dropped into the ear nightly for three nights in succession. On the fourth night the ear-channel should be syringed out with warm,



weak bicarbonate of soda solution, and the plug extracted by a Volk-mann's spoon or small forceps if need be. The ear is then plugged with narrow strips of lint which have been previously saturated in melted mild antiseptic ointment. The meatus soon returns to a normal condition. If eczema of the ear has already developed, syringing with warm, weak soda solution eases the pain, and this, when performed every second or third night, may in itself be sufficient to cure the eczema. If not, the solution should be mopped up after syringing, and boric acid in fine powder blown into the ear. Salicylate of soda solution (1 in 50) is useful in allaying the pain also.

(3) *Circumscribed Inflammation of the External Auditory Meatus*.—This affection usually shows itself in the form of small boils. It is accompanied by a good deal of pain, the patient is usually "run down" in condition, and hence requires systemic as well as local treatment. The latter consists in incision of boils and syringing with warm, weak boric solution. Strips of lint soaked in carbolic oil (1 in 40) are very soothing as well as healing.

(4) *Sweat Rashes*.—These are common, and are usually of an erythematous type, often scarlatiniform. A strong dose of calomel usually has the best effect.

(5) *Callosities*.—(a) *Onsetters' Hands*.—This is a rare and peculiar condition resembling Dupuytren's contraction. Coal is removed from the place where it is hewn to the pit-mouth in tubs. Youths, called onsetters, have to push and pull these tubs, which are simply small railway waggons capable of holding, say, six hundredweights of coal. They do so by grasping the upper rim of the tub with the hands in a position of semiflexion. The movements of the hands cause oft-repeated pressure on the palms and on the flexor surfaces of the digits, with the result that the skin gets thickened and callosities form on the areas exposed to pressure. No pain is experienced, but the retraction of the fascial structures is slowly progressive, and results in a varying degree of flexion of the digits. The middle finger suffers most, and hence differs from Dupuytren's contraction, in which the middle finger is not so much flexed as the two inner ones. The condition is often bilateral. Hot baths nightly, followed by energetic inunction with fatty substances, or the application of stimulating liniments, entirely fail to make any lasting impression except at a very early stage. Subcutaneous division of the contracted structures seems to be the only real remedy.

(b) *Yard-Stick Callosities*.—Officials carry yard-sticks occasionally whilst traversing the low passages of the pit, and callosities sometimes result from the grasp taken. Such a condition might prove useful in the identification of officials found dead. In one instance brought to my notice by Dr. Trotter of Bedlington the official obtained support from his yard-stick while walking in a stooping position by grasping his wand about the junction of its upper and middle thirds in such a manner that two callosities were produced. By fully flexing the little finger of the right hand on the palm, and opposing the thumb to the other three the yard-stick was grasped in such a way that a callosity developed on the extensor aspect of the proximal phalanx of the little finger, and another on the flexor and inner surfaces of the base of the thumb.

(c) *Pick-Shaft Callosities*.—Every hewer shows a number of callosities on both hands produced by the constant grasping of the pick-shaft



whilst working. These vary in position according as the hewer is left- or right-handed, but only to a slight degree, as the miner may have to use his left hand most the one day and the right the next.

*B. CHEMICAL CAUSES DIVISION:—*

(1) *Creosote Rash*.—Props of wood are used to support the roof of the mine, and the process of placing these in their positions is called "timbering." The props themselves are soaked in preservative solution or solutions to protect them from fungi and moisture in the pit. I am unable to give the composition of any of the preserving fluids—the formulæ seem to be trade secrets; but since the preparations smell vigorously of creosote, the rash is here termed the Creosote Rash. Miners are afraid of handling too many "pickled props," which are black-stained and used for the dampest parts of the pit. One meets with the creosote rash usually in adolescents who have been engaged in handling creosoted logs for several days in succession. The sites of predilection are the hands and wrists, face and neck. The rash makes its appearance in the form of a large number of small papules about the size of a pin's head, but gradually passes from this erythematous condition through a vesicular stage into a pustular one. The pustules tend to burst, and the condition assumes the appearance of a pustular eczema. The dark-brown staining material contained in the preserving fluid may assist in the production of the creosote rash. As a complication of this affection I may mention conjunctivitis, both simple and purulent. This is produced by the pitman rubbing his eyes with his unwashed hands while at work or before he takes a bath. The treatment which yields the best results consists in bathing the affected parts with a solution of salicylate of soda (1 in 50) for fifteen minutes every morning, and following this up with a liberal application of boric acid ointment—the whole to be repeated at bedtime. This is assisted by a general tonic or salicylate of soda internally, the affected parts being kept at rest as much as possible.

The general symptoms accompanying the rash are briefly as follows:—Shivers, loss of appetite, headache, backache, malaise, and sickness. Papular rash appears when temperature is about 101° F. Temperature falls to about 99·5° F. when vesicular rash exhibits itself, and rises to 102·5° F. or higher when the vesicles become pustular. It then gradually falls to the extent of one degree daily until it reaches normal. The skin shows no sign of pitting, and the vesicles are not umbilicated.

(2) *Water-Rash*.—This eruption may be present on any part of the body, although it favours the hands, forearms and arms, face and neck, and the feet and legs. It occurs in those who do not handle props as well as in those who do, and simulates the creosote rash in many of its symptoms. It is apparently caused by the water in the pit, either by its dripping on the pitman whilst at work, or by his getting wet with water lying on the floor of the mine. The whole course of the disease, the rash especially, simulates smallpox. The rash is first papular, then vesicular, and finally pustular. Some of the pustules show distinct umbilication. The systemic disturbance is also similar to that of an infectious disease. Pit-water in percolating into the pit dissolves many irritating materials. In addition there is, comparatively speaking, a good deal of sulphuretted hydrogen and sulphur dioxide in the air of mines, and these when dissolved in the water may act as factors of causation, just as in the case of Delhi boils. The treatment consists in administering a good diaphoretic and diuretic mixture regu-



larly. The diet should be light and non-stimulating, and the patient should be confined to bed. This rash seems to be a forerunner of the eczema of the feet and legs which one occasionally meets with in old miners.

(3) *Eczema of the Upper and Lower Extremities*.—This is an aggravating condition to cure. When fully developed it attacks both hands and wrists as well as the dorsum of each foot, and it may be that even the legs are included. The skin peels off in large flakes from the palms of the hands, and fissures usually extending down to the true skin make their unwelcome appearance. Both hands suffer equally. The condition is a very serious one to the miner, causing him much pain and anxiety through loss of working-time. Undoubtedly one can remove the disease by removing the cause in time, but pitmen show no delight in changing their occupation unless really compelled to do so from the severity of the skin lesion. One must therefore adopt the principle of trying to avoid depriving the skin of its natural lubricant, and to supply a substitute where the lubricating material is deficient. The handling of props ought to be discontinued therefore, and carbolic oil (1 in 40) should be energetically rubbed in night and morning. Lead and opium lotion gives relief, as also an ointment consisting of ammoniated mercury and oxide of zinc. Despite all kinds of treatment, however, the disease may remain perfectly incurable.

**Diabetes.**—PANCREATIC DIABETES.—Opie's work on the relation of pancreatic disease has attracted a great deal of attention, but his views are not universally held as proved correct. According to his theory, diabetes is associated with a lesion of the bodies in the pancreas known as the islands of Langerhans. Opie described two forms of interstitial pancreatitis—an interlobular and an interacinar type. In the interacinar variety the chief new development of connective tissue takes place between the acini, and is likely to involve the islands of Langerhans. The lesion characteristic of diabetes is either a disappearance of many or all of the islands, or a hyaline degeneration. The pancreas may show no changes to the naked eye, although extensively involved on microscopic examination. On this theory it is easy to explain why some cases of gross lesion of the pancreas are associated with diabetes, and others not; and also why in some cases of diabetes the pancreas appears diseased, while in others it is healthy to the naked eye. The theory involves the assumption that the islands are intimately related to carbohydrate metabolism, possibly by furnishing an internal secretion to the body fluids. A very ingenious explanation of the nature of the glycolytic action of the pancreas has been promulgated by Cohnheim. He found that, whereas neither pancreatic juice (expressed from the crushed gland) nor muscle juice was glycolytic, a mixture of the two was actively glycolytic. He suggests that the two tissues provide complement and amboceptor respectively, which together split up glucose, or, alternatively, that the muscle juice contains a proenzyme, which requires to be activated by a pancreatic ferment before it becomes glycolytic. The objections to Opie's theory of the function of the islands of Langerhans are partly based on the anatomy and development of the structures (see DIGESTION, p. 150). Van Noorden states that Cohnheim's experiments have been completely disproved by experiments in his laboratory. He believes that probably all cases of real diabetes are of pancreatic origin, but doubts whether Langerhans islands are really blood glands.



**RENAL DIABETES.**—Phloridzin poisoning leads to diabetes—"phloridzin diabetes." This is due to a lesion of the renal epithelium, whereby the cells become permeable to the sugar normally present in the blood. Attempts have been made to show that renal diabetes may occur in man (apart, of course, from phloridzin diabetes, which is only observed experimentally in animals). In renal diabetes it would be necessary to prove (1) that the glycosuria was largely independent of the carbohydrates of the food, and (2) that the sugar in the blood was at least not increased, but rather diminished, in consequence of the loss by the kidneys. Klemperer's case is usually quoted in support of the existence of "renal diabetes." The patient suffered from chronic nephritis, and excreted considerable quantities of sugar, but did not suffer from hyperglycæmia. Van Noorden looks on the case as doubtful. He points out that, if renal diabetes exists, it must have a clinical course quite different from ordinary diabetes, agreeing only in having glycosuria as a symptom. There is great doubt as to whether true renal diabetes actually exists.

**DIABETES AND OBESITY.**—That diabetes is often associated with obesity is well known, and Van Noorden has recently brought forward a suggestive theory of the connection which exists between the two conditions. In health, the carbohydrate of the food which is not at once burned up or stored as glycogen is converted into fat. When carbohydrate metabolism is disturbed, this fat synthesis may also be affected. In some persons there is deficient power of katabolising carbohydrate, but fat synthesis is carried on; in others, both katabolism and fat synthesis are interfered with. In the former case the tissues would be bathed in fluid rich in sugar, which they could not assimilate, but which would be converted into fat. Such patients suffer from faulty metabolism of sugar, but do not eliminate it in the urine. They become obese; the "fat disease" masks the diabetes. Van Noorden gives the following clinical scheme:—

"1. There is the case in which the combustion of sugar, and its conversion into fat, are simultaneously interfered with: glycosuria of various degrees, with wasting; ordinary diabetes.

"2. There is the case in which the combustion of sugar, but not its conversion into fat, is defective: obesity without glycosuria; masked diabetes. These cases readily develop at a later date into—

"3. Cases in which the combustion of sugar is defective, and the heaping up of carbohydrate in the form of excessive fat also begins to fail: obesity with subsequent glycosuria; ordinary diabetes of fat people.

"4. By going a step farther, cases of group 3 become cases of group 1."

**DIABETIC COMA** is now admitted to be due to an acid intoxication from the presence of the acetone bodies, especially oxybutyric acid, in the blood. As has been said in the paragraphs dealing with ACIDOSIS (p. 17), acetonuria is brought about by carbohydrate starvation of the tissues, hence it is easy to perceive that in diabetes, in which carbohydrates are poorly assimilated, an abnormal metabolism of fatty acids may take place, whereby the blood is flooded with acetone and its allies. This fact is practically important, because the sudden withdrawal of carbohydrate from the diet of a diabetic may precipitate acid intoxication. When there is any sign of acidosis—*e.g.* high output of ammonia nitrogen, or a positive ferric chloride reaction in the urine, the proteins



in the diet ought to be diminished, carbohydrate given, and alkalies administered freely. The production of the acetone bodies (ketones) is inhibited by carbohydrates in proportion as the latter are assimilated. Van Noorden points out that oatmeal is well oxidised by some patients, and is therefore beneficial in this respect. The following substances have also an antiketogenous action:—albuminates, pentoses, glyconic acid, glycerin, citric acid.

**DIET IN DIABETES.**—The modern treatment of diabetes is entirely a matter of diet. Special diabetic foods are less used than formerly. Gluten bread, in particular, often contains quantities of starch. Casein breads—*e.g.* casoid meal bread—are practically free from carbohydrate. Janeway, however, objects to them on the ground that casein increases glycosuria more than any other proteid (*Amer. Journ. Med. Sci.*, March 1909). Hutchison has introduced a special sugar-free milk, which can be obtained from Messrs. Callard, Regent Street, W. Janeway points out that in selecting a diet two main points have to be settled: (1) the patient's tolerance of carbohydrate, and (2) the degree of acidosis. The acidosis can be measured by estimating the output of urinary ammonia nitrogen, but in everyday work it is sufficient to apply the ferric chloride test regularly. A positive ferric chloride reaction indicates the free use of alkalies ( $\frac{1}{4}$ -1 oz. of sodium bicarbonate daily), and possibly also the addition of carbohydrates to the diet and restriction of the intake of proteid.

The patient is put on a test diet (I.), with two or three ounces of white bread daily, and the allowance of bread is gradually reduced until the glycosuria disappears, or until he has been for a week on a strict diet without the glycosuria disappearing. If the glycosuria disappears, the case is mild, and bread is added in weighed amounts until sugar reappears. The patient's tolerance of carbohydrate is expressed in terms of two, three, or four ounces of white bread, as the case may be, and the ration of carbohydrate ultimately allowed should be well within this limit (see Table of Equivalents below). If the glycosuria does not disappear, the proteid of the diet should then be restricted (Test Diet II.); should it disappear on this diet, the case is moderately severe; should it persist, severe. In these two classes of cases acetonuria may be looked for.

Having classified the case on the basis of their ability to assimilate carbohydrate, the problem is to maintain adequate nutrition without hyperglycæmia and acidosis. The normal adult obtains from 1500 to 2000 calories daily from carbohydrates, and in diabetes this, or most of this, is lost to the organism (2-4 ozs. bread=240-480 calories). About 600 calories can be supplied as protein, leaving 2000 to be provided as fat. In order to assist in the digestion of so much fat, alcohol is required (Diets I.-II.).

In mild cases, the carbohydrate allowed may be bread or its equivalent. In moderately severe cases, periodical "hunger days" (Naunyn) or "green days" (Van Noorden) should be interpolated. On a "hunger day" the diet consists mainly of broths; the diet of a "green day" is given below (Diet III.). In severe cases, it is doubtful whether adding carbohydrate to the diet will overcome acidosis, because the carbohydrate does not enter into the metabolic processes of the body, and is therefore valueless in aiding the oxidation of the fatty acids. Butter given to such patients should be thoroughly freed from butyric acid by washing.



## I.—STANDARD STRICT DIET.

*Breakfast.*

Coffee, with  $1\frac{1}{2}$  ozs. cream.  
 2 eggs cooked with  $\frac{1}{2}$  oz. butter.  
 3 ozs. ham.

*Lunch.*

Soup, with 1 raw egg.  
 3 ozs. steak, chicken, or lamb.  
 1 oz. bacon.  
 2 tablespoonfuls green vegetable, with  
 $\frac{1}{2}$  oz. butter.  
 Custard—1 egg and  $1\frac{1}{2}$  ozs. cream.  
 6 ozs. wine or 1 oz. whisky.

*Afternoon Tea*, with  $\frac{1}{2}$  oz. cream.

*Dinner.*

Clear soup.  
 3 ozs. fish, with  $\frac{1}{2}$  oz. butter.  
 $\frac{1}{4}$  lb. roast beef, mutton, etc.  
 Vegetables, as lunch.  
 Salad, with  $\frac{1}{2}$  oz. oil.  
 1 oz. cheese.  
 Wine, as lunch.

Protein	=	126 grams ;	515 calories.
Fat	=	222 „	2065 „
Carbohydrate	=	15 „	60 „
Alcohol	=	30 „	210 „
			<hr/>
			2850 „

## II.—DIET WITH RESTRICTED PROTEID.

*Breakfast.*

Coffee,  $1\frac{1}{2}$  ozs. cream.  
 2 eggs,  $\frac{1}{2}$  oz. butter  
 1 oz. bacon.

*Luncheon.*

2 eggs.  
 1 oz. bacon.  
 2 ozs. chop, ham, beefsteak, chicken,  
 or fish, broiled, with  $\frac{1}{2}$  oz. butter.  
 Vegetables, etc., as in Diet I.

*Afternoon Tea*,  $\frac{1}{2}$  oz. cream.

*Dinner.*

Clear soup.  
 $\frac{1}{4}$  lb. roast pork, beef, mutton, lamb,  
 or chicken.  
 Vegetables, etc., as in Diet I.

Protein	=	82 grams ;	334 calories.
Fat	=	215 „	2008 „
Carbohydrate	=	15 „	60 „
Alcohol	=	30 „	210 „
			<hr/>
			2612 „

## III.—“GREEN DIET.”

*Breakfast.*

1 egg.  
 Cup of black coffee.

*Dinner.*

Spinach and egg.  
 $\frac{1}{2}$  oz. bacon.  
 Salad, with  $\frac{1}{2}$  oz. oil.  
 6 ozs. wine or 1 oz. brandy.



*Afternoon.*

Beef-tea or chicken broth.

*Supper.*

Scrambled egg, tomato, and butter.

 $\frac{1}{2}$  oz. bacon.

Cabbage, asparagus, or other green vegetable.

Cup of tea.

 $\frac{1}{2}$  oz. sodium bicarbonate in 24 hours.*Table of Equivalents to 1 oz. White Bread.*

1 oz. bread, roll, or biscuit.

5 ozs. boiled or  $1\frac{1}{2}$  ozs. raw oatmeal. $3\frac{1}{2}$  ozs. boiled macaroni. $2\frac{1}{8}$  ozs. boiled rice.

3 ozs. cooked potatoes.

 $3\frac{1}{2}$  ozs. cooked green peas.

1 oz. lentil flour.

10 ozs. milk.

4 ozs. apples.

 $2\frac{1}{2}$  ozs. bananas. $3\frac{1}{2}$  ozs. almonds. $3\frac{1}{2}$  ozs. cherries. $2\frac{1}{2}$  ozs. plums.

VON NOORDEN'S "OATMEAL CURE."—Von Noorden advises a special oatmeal cure in certain cases of diabetes. He states that in many cases oatmeal is well borne in comparison with other carbohydrates. This only applies when oatmeal is given alone; when added to a mixed diet it seems to have no special advantage. The oatmeal is given in the form of well boiled gruel or porridge, to which eggs, or vegetable protein, and butter are added. Brandy and strong black coffee are also allowed. The ordinary daily ration consists of oatmeal 250 grams (9 ozs.), 7 or 8 eggs, and (300 grams) 10 ozs. of butter. On this treatment some diabetics become free from sugar, although they remained glycosuric on a strict diet. Von Noorden distinguishes three possible good results:—(1) Glycosuria disappears; (2) glycosuria diminishes; (3) glycosuria uninfluenced, or may even rise, but the assimilation of carbohydrate is improved, and acidosis is overcome. The cure is not always successful. Von Noorden advises it only in severe cases with acidosis. Why oatmeal is tolerated better than other carbohydrates is not known. Siegel reports good results, and Langstein treated a child of  $1\frac{1}{2}$  years thus with some success. When first introduced, the oatmeal diet was given continuously for several weeks; now Von Noorden advises that it should be limited to 3-day periods, each preceded by one or two "green days," interpolated in the ordinary régime of strict dieting.

REFERENCES.—VON NOORDEN. *Berl. klin. Wochensch.*, No. 36, 1902; *Deutsche Aerzte-Zeitung*, Heft 22, 1902.—SIEGEL. *Berl. klin. Wochensch.*, p. 45, 1904.—LANGSTEIN. *Ibid.*, March 1905.

SECRETIN IN THE TREATMENT OF DIABETES.—When the hormone secretin was discovered by Bayliss and Starling (see DIGESTION), its remarkable effect on the secretion of the pancreas led to its being tried as a remedy for diabetes, on the theory that the latter was due to failure of an internal secretion of the pancreas. Secretin was usually given in the form of an acid extract of the duodenal mucous membrane. Unfortunately the results of the secretin treatment have not realised anticipations, though some favourable cases have been reported. Little has been heard of it during the past year or two.

REFERENCES.—MOORE, EDIE, and ABRAM. *Biochemical Journ.*, p. 28, 1906.—FOSTER. *Journ. Biological Chemistry*, Jan. 1907.—DAKIN and BRANSOM. *Ibid.*

**Diet.**—Chittenden's work (*Physiological Economy in Nutrition*) on the amount of proteid required by the normal adult has led to a great



deal of discussion since its publication in 1904. Voit's standard dietary, which was based on the average of a large number of observations on actual diets, and was given as that suitable for a man of 11 stones doing moderate work, is 118 grams protein, 56 grams fat, and 500 grams carbohydrate—roughly equal to 3000 calories. Chittenden found that he could maintain himself in nitrogenous equilibrium on a diet containing only from 37 to 40 grams of protein, and furnishing from 1500 to 1600 calories. He instituted a series of observations extending over several months on 26 individuals who were divided into three groups—(1) the laboratory staff; (2) volunteers from the army medical corps; (3) students engaged in athletics. The first and second groups were doing moderate, the third group hard, muscular work. The main restriction on the diet was to enjoin moderation, and, without in most cases eliminating animal food from the diet, Chittenden gradually reduced the protein intake very greatly below Voit's standard. It was found that to keep these men in nitrogenous equilibrium only from 47 to 55 grams of protein were required. In most cases there was a slight initial fall in weight, but thereafter the weight remained stationary at the new level. Bodily strength was gained (100 per cent. as registered by the dynamometer in group (2); 50 per cent. in the case of the athletes who were previously in training); endurance was heightened; the subjects enjoyed a feeling of increased well-being, and remained in excellent health throughout the experiment.

Chittenden's experiments undoubtedly prove that the *minimum* protein intake required is much below Voit's standard. In the opinion of most competent judges, however, they do not prove that this minimum standard is also the *optimum*. It is urged that Chittenden's subjects were in an exceptional position; they were leading quiet, regular lives, with ample sleep and abstinence from alcohol; their work, though hard, was that to which they were accustomed; they were interested in it, and in the experiment they were making. These circumstances, along with a natural enthusiasm for the new régime, tended to favour the success of the experiment. The chief arguments against the general adoption of a very low protein standard are, that it may not improbably lower the power of resistance to disease, and that Voit's standard has proved reliable from a hygienic and social standpoint.

**PURIN-FREE DIET.**—A purin-free diet has been advised in gout and other conditions—renal disease, headaches, migraine, recurrent vomiting, etc., on the theory that such conditions are associated with the retention or abnormal metabolism of uric acid. The purin bodies are formed from nucleo-proteids; their relations are shown in the following:—

Purin . . .	$C_5H_5N_4$	} oxypurins.
Hypo-Xanthin . .	$C_5H_5N_4O$	
Xanthin . . .	$C_5H_5N_4O_2$	
Uric acid . . .	$C_5H_5N_4O_3$	
Adenin . . .	$C_5N_4H_4NH$	} amino-purins.
Guanin . . .	$C_5N_4H_4ONH$	
Caffeine . . .	$C_5N_4H(CH_3)_3O_2$	trimethylxanthin.
Theobromine . .	$C_5N_4H_2(CH_3)_2O_2$	dimethylxanthin.

Uric acid arises from two sources—(1) from the nucleo-proteins and purin bodies of the food—*exogenous uric acid*; (2) from the disintegration of the nuclear tissues of the body, and from the metabolism of muscles (Burian)—*endogenous uric acid*. The amount of endogenous uric acid



excreted may be estimated by placing the subject on a diet approximately free from purins. It is then found to vary considerably in different persons, but to remain at a fairly constant level in each individual; the average amount is from .3 to .6 gram. In some persons the metabolism of purin bodies appears to be abnormal. Cases are recorded in which on a purin-free diet the output of uric acid was much higher than the above, and others in which, after the consumption of articles rich in purin, enormous quantities of uric acid were excreted for a considerable period. Observations of this kind render the existence of "a uric acid diathesis" at least probable.

Purins are contained in many articles of ordinary food, especially those which are rich in nuclei. All forms of fish and flesh, particularly sweetbread, liver, and the like, contain purins; the pulses, oatmeal, and asparagus yield a considerable amount; tea, coffee, and malt liquors contain smaller quantities.

White bread, rice, eggs, vegetables other than the above, nuts, dates, macaroni, raisins, milk, cream, butter, fruits, fat, and honey are practically free from purin. Guanin and adenin, the purin bodies derived from sweetbread (pancreas and thymus), are absorbed from the bowel with difficulty, and can be recovered from the fæces. It is therefore doubtful whether these should be classed as purin-containing foods from this point of view. The whole question of the value of a purin-free diet is unsettled. Luff believes that its benefit is due to its low proteid content. The metabolism of the purin bodies is discussed in Von Noorden's *Metabolism and Practical Medicine*, vol. i., London, 1907.

**Digestion.**—MOVEMENTS OF THE ALIMENTARY TRACT.—The movements of the stomach and intestine during digestion have been studied by Cannon in unanæsthetised animals by means of X-rays. To the food (bread and milk) given sufficient subnitrate of bismuth is added to render it opaque to the rays. The *stomach* is divided functionally (*v. infra*) into two portions—the fundus, and the pyloric part or antrum. In the living animal this division is marked by the transverse band of the stomach—a contraction of the circular fibres—which separates the large sac-like fundus from the small pyloric antrum. When food enters the stomach it first accumulates in the fundus, being cut off from the pylorus by constriction of the transverse band, and during the whole process of digestion the fundus remains steadily contracted on its contents. In about twenty minutes or half an hour rhythmical contractions set in, beginning on the cardiac side of the circular fibres, and these pass towards the pylorus, into which they drive part of the food from the fundus. The pyloric sphincter remains firmly closed, and the food which is driven along the pyloric antrum is squeezed back in an axial stream towards the fundus again. It is thus thoroughly mixed in this pyloric mill, and every part of it is brought into intimate contact with the mucous membrane. At intervals during digestion the pyloric sphincter relaxes, and allows a little of the now fluid gastric contents to escape into the duodenum. As the stomach gradually discharges its contents it little by little assumes the shape of a curved tube. Cannon shows that two factors are concerned in the mechanism of the emptying of the stomach—pressure on the food at the pylorus by the recurrent gastric waves, and the action of the pyloric sphincter. The pylorus is tonically closed when food is ingested, and remains closed against recurrent pressure. The appearance of acid at the



pylorus causes the sphincter to relax. The pressing peristaltic waves now force some of the acid chyme into the duodenum. The acid in the duodenum at once tightens the sphincter against further exit. This is what is known as the "acid control" of the pylorus. Carbohydrates stimulate secretion, but do not combine with acid, hence they escape quickly. Proteids fix acid and delay the development of an acid reaction. Fats make a slow continuous exit from the stomach. Cannon has recently (*Amer. Journ. Phys.*, Nov. 1908) discussed "acid control" of the cardiac sphincter. He concludes that it is kept closed by the presence of acid in the stomach. Neutralisation of acid leads to regurgitation, which continues until the normal acidity of the stomach is regained. *Intestine.*—During digestion the food in the small intestine forms a continuous column. Contractions of the wall of the gut appear, the effect of which is to divide the column into a series of segments. At intervals of a few seconds each of these segments is divided into two halves by a fresh constriction, and the adjacent halves of the old segments fuse. There is thus a constant successive formation of new segments, and undoing the old ones, the effect being to bring every particle of chyme into close relation with the intestinal wall. This process of segmentation does not drive the food onwards; that takes place by true peristalsis—*i.e.* a co-ordinate proximal contraction and distal relaxation of the walls of the bowel. The food gradually escapes into the cæcum by periodical relaxation of the ileo-cæcal valve. As the cæcum and ascending colon fill up, contractions pass along the bowel in a backward direction, driving the contents of the colon into the cæcum and churning them up there. As more and more food enters the large intestine while this churning is taking place, the transverse colon gradually becomes filled. In consequence of the mixing to which they are subjected the contents of the bowel lose water, and are gradually transferred to the descending colon, which is mainly a channel for storage.

All the movements of the alimentary tract depend on a nervous mechanism, and are not produced through the agency of internal secretions or hormones (*v. infra*). True peristalsis—proximal contraction and distal relaxation of a segment of the bowel—is a co-ordinated movement depending on a central mechanism in the medulla or cord. The movements of the stomach described above occur independently of the extrinsic nerves, and must, therefore, be controlled by the nerve plexuses in the walls of the viscus, or, as Starling supposes, be of myogenic origin. Bayliss and Starling regard the local contractions of the small intestine as myogenic.

**GASTRIC DIGESTION.**—The mucous membrane of the stomach is divisible into two parts—the cardiac four-fifths and the pyloric fifth. In the living animal these are distinguishable, and are demarcated by a transverse band. The glands in the fundus secrete hydrochloric acid and pepsin; those of the pylorus, pepsin only. After the insalivated bolus of food is swallowed it lies in the fundus, and the acid gastric juice penetrates it so slowly that salivary digestion goes on in its interior for twenty minutes or half an hour. The secretion of gastric juice consequent on a normal meal consists of two phases—(1) a large amount which is reflexly secreted immediately, and (2) a smaller quantity which is excited chemically during the later stage of digestion by the presence of food in the stomach.

(1) "*Appetite Juice.*"—Pawlow's experiments prove that the flow



of gastric juice into the stomach which occurs at the beginning of a meal is a reflex phenomenon. In a dog with a gastric fistula direct irritation of the lining of the stomach evokes no secretion, but the sight of food, especially if the animal is hungry, produces a copious flow. If an œsophageal fistula is made, so that food swallowed does not enter the stomach, and the dog be fed, gastric juice begins to flow five minutes after the "sham feeding" commences. As the sham feeding does not appease the dog's appetite, it will go on eating for hours, during the whole of which period the juice flows freely. The reflex arc which controls this phase of gastric secretions has, therefore, several afferent channels—sight, smell, etc.; its efferent path is by the vagus, for division of both vagi prevents the flow, and stimulation of their divided ends produces it.

(2) "*Chemical*" *Juice*.—The second phase of gastric secretion is independent of the above mechanism, because it occurs even after all the nerves going to the stomach are divided. Neither is it due simply to the mechanical presence of food, because some foods do not produce it. The foods which are most active in exciting it are soups and extracts of meat, and these act only when introduced locally into the stomach, not when they are injected into the circulation. The earlier explanation of this fact was that the second phase of gastric secretion was controlled by a peripheral reflex mechanism, but Edkins has proved that the correct interpretation is quite different. The second phase of gastric secretion is really the result of a specific chemical excitant which is produced in the pyloric mucous membrane by the first products of digestion. This chemical excitant is called the *gastric secretin*, or *hormone* (see HORMONE). In an anæsthetised animal's stomach which has been completely cut away from all extrinsic nerves, and into which no food enters, the introduction by way of the vessels of a decoction of pyloric mucous membrane causes a flow of gastric juice. The injection of bouillon, or of decoctions of cardiac mucous membrane, has no such effect.

Gastric digestion, therefore, is due to the co-operation of two factors:—The first gastric secretion, aroused by appetite and mastication, is of fairly constant composition. Its acidity equals .48 per cent. HCl. If allowed to act on proteids for a sufficient time, amino-acids and other of ultimate products of proteolysis are formed, but if the time of digestion be restricted to four or six hours, only albumoses and peptones are produced. The second gastric secretion, which appears long after the appetite is satisfied, varies considerably according to the nature of the food and the amount of hormone it produces. The quantity of gastric secretion is diminished by the administration of oil, or of alkalies; acids increase it.

PANCREATIC SECRETION.—The greatest flow of pancreatic juice occurs during the third hour after a meal, at the time when the largest quantity of acid chyme is entering the duodenum. The secretion is excited by the flow of an acid into the beginning of the small intestine. This action does not take place through the agency of the vagus or splanchnic reflex arc, for secretion is undisturbed even though these nerves are cut. Bayliss and Starling have shown, moreover, that pancreatic secretion can be excited by the injection of acid into a loop of duodenum which has been entirely deprived of all nervous connection with the pancreas. It follows that the effect is a chemical one, taking place through the blood-stream. The same observers also found that intra-venous injection of an extract made by pounding up duodenal mucous



membrane with dilute hydrochloric acid caused a profuse flow of pancreatic juice. The active substance, which has not been isolated, is called *secretin*. Secretin does not exist as such in the cells of the mucous membrane, but is formed by hydrolysis from a body known as *prosecretin*. The nervous system probably plays no part whatever in the secretion of the pancreas.

CHANGES IN THE PANCREAS DURING SECRETION.—In addition to the changes described in the *Encyclopædia Medica* (Vol. IX. p. 63), which are strictly analogous to those occurring in salivary glands, a series of special changes of quite a different nature occur. These concern the islands of Langerhans. These islands are not, as has been supposed, structures independent of the rest of the gland tissue, but represent phases in the life history of the secreting alveoli. They consist of rounded masses of small polygonal cells which stain with difficulty, and, in consequence, they stand out prominently from among the rest of the glandular structures. They are developed from the secreting acini as a result of exhaustion of the gland, and when this exhaustion is extreme (which can be brought about by repeated injections of secretin) the islets spread diffusely through the pancreas. The proportion of islet tissue is also increased by prolonged inactivity—*e.g.* from starvation. “Since the islets are in constant process of formation from alveoli as a result of activity, there must be a constant disappearance of the islets and new formation of alveoli to maintain the balance between the tissues. The embryological evidence brought forward by Laguesse, as well as by Dale’s experiments on the toad, show that pancreatic growth is a function of the islets, cell multiplication being observed only in the islets which are produced as a result of extreme activity” (Starling). There is no evidence that Langerhans’s islands are organs producing an internal secretion, or that they are in any way specially connected with carbohydrate metabolism.

The *pancreatic juice* is alkaline. Its alkalinity corresponds closely with the acidity of the gastric juice. The normal juice contains no trypsin, and has no effect on coagulated proteid. It, however, contains trypsinogen, and when it comes in contact with the intestinal juice it acquires very powerful proteolytic properties from the conversion of the trypsinogen into trypsin. This conversion is brought about by a ferment—*enterokinase*—in the intestinal juice. The spontaneous conversion of trypsinogen into trypsin, described by earlier observers as taking place in extracts of pancreas, was due to accidental contamination with intestinal juice. Enterokinase is a specific ferment of the intestinal mucous membrane. Its relation to trypsinogen is probably that of a ferment, not, as has been suggested, that of complement to amboceptor, in which the trypsinogen links the enterokinase to the proteid molecule.

BILE.—The flow of bile runs parallel to that of the pancreatic juice—it is greatest during the third hour of digestion. The excitatory mechanism is the same as that of the pancreatic juice—the secretin formed in the cells of the duodenal mucous membrane by the acid chyme. The action of bile in facilitating the splitting of fats by the pancreatic juice depends on the bile salts it holds in solution. The solution acts physically, by lowering the surface tension between oily and watery fluids, and also has the power of dissolving fatty acids and soaps. It thus acts as a vehicle for conveying fats in solution through the basilar epithelium lining the gut into the deeper layers of cells, where resynthesis of the fat occurs and the bile salts are released to



return to the liver. There they act as cholagogues and are rapidly excreted.

**INTESTINAL JUICE.**—The secretion of intestinal juice begins soon after a meal, and attains its maximum during the third hour of digestion. It is probably excited by a hormone-secretin, and is also produced by mechanical irritation. It contains enterokinase, and a ferment named erepsin, which, though it has little action on proteids, splits up the results of proteolysis—albumoses and peptones—into further cleavage products. It also contains ferments acting on sugars—invertase, which converts cane-sugar into glucose and lævulose; maltase, which converts maltose into glucose; and lactase, which converts lactose into glucose and galactose.

**REFERENCES.**—*Recent Advances in the Physiology of Digestion.* By E. H. STARLING. London, 1906.—PAWLOW. *The Work of the Digestive Glands* (trans. THOMSON). London, 1902.

**Digestive Functions, Tests for the.**—From time to time a number of new tests for the digestive functions have been devised, but many of them seem scarcely to have been employed except by their inventors. The following, however, have enjoyed a certain amount of popularity, and have given rise to some discussion in the medical journals.

**EINHORN'S TEST.**—This is an ingenious though rather complicated procedure. The principle is to administer a capsule containing a series of substances which should normally undergo digestion in different parts of the alimentary tract, each substance having attached to it a coloured glass bead. The beads are subsequently recovered from the stools, and the amount of digestion of the attached material is determined. The test substances are—catgut, thin fish bone, fibre of raw beef, potato with a piece of the skin, fat, and thymus. Catgut is digested in the stomach and intestine, fish bone in the stomach only—from the state of the corresponding beads the relative activity of the stomach and intestine is estimated. The raw beef, potato, and fat give a clue to the digestion of proteid fat and starch. Thymus is used to test the activity of the pancreas. Unless the pancreas is active the nuclei of the thymus are not digested.

**REFERENCES.**—EINHORN. *Arch. f. Verdauungsk.*, 20th Feb. 1906; *ibid.*, 28th Feb. 1907; *ibid.*, 25th Oct. 1907.

**SAHLI'S DESMOID REACTION.**—This depends on the fact that raw connective tissue is digested only by the gastric juice, not by the pancreatic or intestinal solution. It is therefore a test of gastric activity, and was intended to replace, or to be an adjunct to, the use of the test meal. "Desmoid capsules" consist of small rubber bags containing methylene blue. The mouth of the bag is tightly tied up with fine catgut. One of these is swallowed during a meal, and when the catgut is loosened by digestion the methylene blue is set free and discolours the urine. It seems that if the drug appears in the urine within eight hours of administration, the functions of the stomach may be regarded as active.

**REFERENCES.**—SAHLI. *Corr. Blatt. f. Schweiz. Aerzte*, pp. 8-9, 1905; *Deutsche med. Wochensch.*, No. 30, 1907.—HILLMAN. *Arch. f. Verdauungsk.*, 28th Aug. 1907.—HORWITZ. *Ibid.*, 30th Aug. 1906.



**SCHMIDT'S TEST DIET.**—To estimate the functional activity of intestinal digestion, Schmidt gives a diet consisting of—Breakfast, half a litre of milk or cocoa and 50 grams of rusks. Lunch, half a litre of gruel (40 grams oatmeal, an egg, 10 grams butter, 200 grams milk, 300 grams water). Dinner, 125 grams underdone minced meat cooked with 20 grams butter, and 25 grams of potato purée (mashed potato, milk, and butter). Afternoon, as breakfast. Supper, as lunch. The essential components of the diet are the cereals and the underdone meat. The diet is continued for several days; some colouring matter (charcoal) may be added to show when the stools are beginning to be affected. The fæces are rubbed up with water and a quantity is spread out for examination on a suitable black surface. They are then examined for (1) mucus; (2) residue of connective tissue and muscular fibre; (3) carbohydrate residue; (4) fat. The examination is conducted with the naked eye, and by the microscope.

*Mucus* indicates intestinal catarrh. Large shreds occur in mucous colitis, and in affection of the colon generally (*e.g.* constipation masked by irritative diarrhœa); small, bile-stained flakes of mucus come from the small intestine. *Connective tissue fibre.*—If these are present, gastric digestion is deficient, for the gastric juice alone can digest fibrous tissue. Muscle fibre is digested both in the stomach and intestine. Connective tissue may be found either on account of gastric inadequacy, or because the contents of the stomach are hurried too rapidly into the duodenum. Therefore connective tissue residue only = gastric indigestion; muscle fibre alone = intestinal indigestion; connective tissue and muscle fibre = gastric and intestinal indigestion. *Carbohydrate.*—Only a few cells of potato should be found under normal circumstances. If there is any excess, the digestion of starch is faulty. Under the name of “intestinal dyspepsia with fermentation,” Schmidt describes a symptom-group of colic, loose stools containing quantities of starch but no fat or proteid, and malnutrition. *Fat* is rarely present. Excess can only be estimated roughly, hence the diet gives little information as to the digestion of fat. If the stools are normal, or nearly so, solid particles are so small as to require microscopic examination for their identification. Three slides are made—one of the liquid fæces alone, one stained with iodine in iodide of potash to show starches, and one with the addition of 30 per cent. acetic acid to dissolve soaps and lime salts and show fatty acids. Chemical examination has also been resorted to (Steel) and a fermentation test has been applied, but the main information obtainable from the test diet is got by simple inspection.

**REFERENCES.**—SCHMIDT. *Die functionsprüfung des Darmes mittels der Probekost* (Wiesbaden), 1904.—ROUX and RIVA. *Gaz. d. Hôp.*, 17th June 1905.—STEEL. *Med. News* (New York), 16th Dec. 1905.

**OCCULT BLOOD IN THE FÆCES.**—By the term “occult hæmorrhage” is meant that the amount of blood is so small as to elude visual detection, and requires the application of chemical tests for its recognition. The presence of even these very minute quantities of blood in the motions is sometimes of considerable diagnostic importance in deciding as to the presence or absence of gastric cancer or ulcer. Boas states that in hyper- and hypo-chlorhydria, in hyper-secretion, and in simple dilatation occult blood is never found. In cases of pyloric stenosis secondary to ulcer, it may or may not occur, while in gastric cancer it is invariably, and in gastric ulcer usually, present. Certain precautions must be



taken in testing for occult blood. For two or three days before the test is made the patient's diet must have contained nothing which will give a reaction—*i.e.*, no flesh, no meat extract containing hæmoglobin. A stomach tube must not have been passed recently, as it may have caused an abrasion of the œsophageal or gastric mucosa. Other sources of hæmorrhage—mouth, gums, throat, nose, piles, must be excluded. Among the tests employed are—(1) the guaiac reaction; (2) the aloin reaction; (3) the benzedin reaction. The last is extremely delicate.

**GUAIAC AND ALOIN TESTS.**—Rub down with water a piece of fæces the size of a walnut, and add to 5 or 6 c.c. of the fluid one-third of its volume of acetic acid. Shake thoroughly, and extract with 6-8 c.c. ether. When the mixture clears, pour the ether off into two tubes; to one add tincture of guaiacum, to the other tincture of aloes, and to both add 20-25 drops of oil of turpentine. A blue colour in the one case, a cherry red in the other, shows that blood is present.

**BENZEDIN TEST.**—Dissolve as much benzedin puriss. (Merck) as will lie on the point of a knife in 2 c.c. glacial acetic acid. Infuse a pea-sized mass of fæces in a test tube full of boiling water (to destroy ferments) and add a few drops of the liquid to a mixture of 10 drops of the benzedin-acetic acid solution, and 2 or 3 c.c. commercial solution (3 per cent.) of hydrogen peroxide. The presence of blood is shown by a deep greenish-blue colour.

**REFERENCES.**—SCHLOSS. *Arch. f. Verdauungsk.*, 30th June 1904.—HARTMANN. *Ibid.*, 25th Feb. 1904.—DAVIS. *Bost. Med. and Surg. Journ.*, 8th Aug. 1907.—GOODMAN. *Amer. Journ. Med. Sci.*, Oct. 1907.

## Drugs, Recent.

ASPIRIN. . . . .	153	FIBROLYSIN . . . . .	154
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**ASPIRIN.**—One of the trade names of acetyl-salicylic acid (also known as Xaxa, etc.). Acetyl-salicylic acid has the same general action as the salicylates, and is in many respects a very useful drug. It seems to be a more powerful analgesic than salicylic acid or sodium salicylate, and often does good in neuralgia, headache, muscular rheumatism, sciatica, lumbago, and the like. Unpleasant symptoms (tinnitus aurium and giddiness) rarely occur, but in some persons it produces nausea. It does not induce perspiration in febrile conditions to the same extent as sodium salicylate. In afebrile cases there is no sweating. Aceto-salicylic acid is best administered in cachets; the dose is 5-15 grs. for an adult. It is decomposed by alkalies, and is incompatible with many other drugs, and therefore should be prescribed alone, without admixture. It does not keep well if exposed to the air as tablets or in powder.

**ATOXYL** is the trade name of an organic compound of arsenic, much employed in the treatment of trypanosome infections, and also in syphilis. Soamin is another name for the same substance. Atoxyl was originally stated to be the anilide of metarsenious acid, but Moore, Nierenstein, and Todd, who have investigated its composition, regard it as a sodium salt of amido-phenyl-arsenic acid, containing the arsenic directly united to the benzene ring. Ehrlich has independently arrived at nearly the same result. Moore and his colleagues find that it is a very stable com-



pound, neither aniline nor arsenic being readily detachable from the molecule by chemical means. Its aqueous solution is, however, strongly dissociable electrolytically. Moore points out that the poisonous effects of atoxyl (of which blindness is one of the most serious) are not those of arsenic, and that on long continued administration neither the toxic action of arsenic on the nervous system nor that of aniline on the blood are seen. He therefore does not believe that the action of atoxyl is due to slow ionisation of arsenic, but thinks it is a direct specific effect of a complex organic ion containing both the aniline and arsenic group. The very rapid action of a single large dose of atoxyl on the parasites (trypanosomes) of a highly-infected animal is in harmony with such a view of its action, and is incompatible with the notion of a slow decomposition of the drug (see SLEEPING SICKNESS). Koch advises the use of atoxyl in doses of half a gram, given subcutaneously on two successive days. In syphilis the dose recommended is from 3 to 7 grs. every second day. If a larger dose be given, headache, giddiness, strangury, cough, and transitory or permanent blindness may be caused. *References*.—Ehrlich, *Berl. klin. Wochensch.*, Nos. 9-12, 1907; Moore, Nierenstein, and Todd, *Biochemical Journ.*, ii. pp. 316-324, 1907.

**BROMURAL**.—The  $\alpha$ -monobrom-isovalerianyl-urea. It is a safe and moderately powerful hypnotic, with apparently no harmful secondary actions. The dose is from 5 to 10 grs. at bedtime, in hot milk, tea, or water. It is sparingly soluble in cold water. It does not seem to be cumulative, and it is not necessary, as a rule, to increase the dose.

**CACODYLIC ACID AND ITS SALTS**.—These are organic combinations of arsenic, by which large quantities of arsenic can be introduced into the system without producing poisonous symptoms. Sodium cacodylate, containing 46.8 per cent. of arsenic, may be given in doses of  $\frac{1}{2}$  to 1 gr.; cacodylic acid (54.4 per cent. of arsenic) in doses of  $\frac{3}{4}$  gr. once daily. The drug is given hypodermically, as a sterile solution ( $\frac{1}{2}$ -1 per cent.). Cacodylates have been used in chorea, tuberculosis, and various skin diseases. They have to a large extent been superseded by atoxyl.

**COLLOIDAL METALS**—"Metallic Ferments"—"Electrosols."—When an electric spark is passed through pure water between terminals of a metal, minute quantities of the metal become diffused through the liquid. The solutions are dichroic, and conform to the tests for colloidal solutions. The metals exist in them in a state of minute subdivision, and the particles possess a vibratory "Brownian movement." Their action depends on their physical constitution, not on any special property of the metal used; gold, silver, platinum, palladium, etc., may be employed. Robin asserts that these colloidal metallic solutions profoundly influence metabolism when injected subcutaneously. They are said to (1) reduce the temperature; (2) raise the blood-pressure; (3) increase the output of urea, uric acid, and urinary indoxyl; (4) cause leucocytosis; (5) decrease the consumpt of oxygen without diminishing the carbonic acid exhaled; (6) increase the coefficient of nitrogenous utilisation. The solutions are believed to act in virtue of the extreme subdivision and separation of the metallic particles; Robin compares the action to the radiant properties of gases in a vacuum tube in which a similar wide separation of atoms prevails. Metallic ferments have been used in pneumonia, etc., it is said, with benefit. Further investigations are required before any conclusion can be formed. *References*.—Robin, *Les ferments metalliques* (Paris), 1907; Iscovesco, *Presse méd.*, 8th May 1907.

**FIBROLYSIN**.—This is a double salt of thiosinamin and sodium sali-



cyate, which is freely soluble in water, and is said to possess a selective action on pathological fibrous tissue, causing in it a softening process which facilitates the absorption or stretching of such cicatricial formations. It is given by intra-muscular injection; for this purpose the sterilised solution sealed in glass tubes, each containing a single dose (3 grs. of thiosinamin in 37 minims), are very convenient. W. J. Stuart (*Folia Therapeutica*, Jan. 1909) prefers subcutaneous injection, near to the scar tissue; the majority of surgeons prefer gluteal injections, as less painful, and unattended by the slight risk of sloughing which is said to accompany subcutaneous injections. There are rarely any unpleasant after-effects. Soon after an injection near a scar the colour of the scar becomes paler and infiltrated with serum. The strands of fibrous tissue swell, and the nuclei become separated (Mendel). "It is of vital importance, from the therapeutic standpoint, to remember that one cannot count on fibrolysin causing actual absorption of scar-tissue; it causes a softening, and must be supplemented by massage, baths, movements, and other mechanical means appropriate to each case, which, without the softening action of fibrolysin, would be ineffective" (Stuart). Fibrolysin may be tried in all conditions in which it is desirable that cicatricial or pathological fibrous tissue should be softened—*e.g.* operation scars, contractions following burns and injuries, scleroderma, lupus, Dupuytren's contraction, etc. It has also been employed in the treatment of corneal opacity, deafness associated with sclerotic processes in the ear, strictures of the urethra and œsophagus in association with the use of bougies, stenosis of the pylorus, polyarthritis, pleuritic thickening, neuritis, and a great many other diseases. The reports of its efficacy vary a good deal, but the remedy is at least worthy of trial in such conditions. Injections should be given on every second or third day; a course of twenty-five or fifty may be required before much improvement is seen, but good results may follow a considerably smaller number.

FORMIC ACID AND THE FORMATES.—Formic acid and the formates have been introduced on account of their supposed stimulant and tonic action on the muscles. It has not been proved that they really have the efficacy ascribed to them; Goodall was unable to ascertain any definite pharmacological action on the blood-pressure, heart-beat, or voluntary muscles. No diuresis was observed. Formic acid is used as a 25 per cent. solution in doses of 2-10 minims; the sodium salt ( $\frac{1}{2}$ -5 grs.) is also employed. Ker and Croom speak favourably of formic acid in preventing heart-failure in diphtheria. The formates are largely used as "tonics," and seem to produce at least a subjective sensation of well-being and to remove fatigue.

HEROIN (acetomorphine) hydrochloride is a morphine derivative chiefly used in respiratory affections. It is a sedative to the respiratory centre, increasing the force of the expiration and inspiration, and reducing the rate. It is also an expectorant, and soothes irritable cough. It does not tend to produce the disagreeable secondary effects of morphia—nausea, constipation, headache. It is not depressant, and does not tend to produce a craving for the drug. It is used in hæmoptysis, and as an expectorant generally. The dose is  $\frac{1}{24}$ - $\frac{1}{6}$  gr. The elixir heroin *c.* terpen. (B.P.C.) is a convenient preparation.

VERONAL.—This is a recently introduced hypnotic drug, also known as malourea. The dose is from 5 to 10 grs. It should be administered about half an hour before bedtime, dissolved in a cup of hot fluid. Toxic symptoms are rare. Its chief use is in simple insomnia; it has also been



employed as a prophylactic against sea-sickness during short voyages, and as an aid to chloroform narcosis, a dose being given an hour before the anæsthetic is administered. Veronal may be administered by the rectum instead of the mouth. It is not cumulative. Proponal is a somewhat similar drug.

## Eclampsia.

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ONE is justified in using the word "enormous" to characterise the literature which has gathered round eclampsia gravidarum during the past five or seven years. New theories of origin have been put forward, and new methods of treatment founded thereon have been tried; but it has still to be confessed that all this wealth of research, with its theoretical discussions and its therapeutical novelties, leaves the mortality of this complication of the pregnant and parturient state very much where it was ten years ago. Eclampsia is still the *opprobrium medicorum* in obstetrics. At the same time, it may be well to indicate briefly the new theories of pathogenesis and methods of treatment, for in some of them may lie concealed the long-looked-for explanation and cure of this disastrous malady or group of maladies.

*Theory of Thyroid Inadequacy.*—This novel theory had its origin in Lange's observations, published in 1899 (*Zeitsch. f. Geburtsh. u. Gynäk.*, xl. p. 34, 1899). Beginning with the fact that normally the thyroid gland is enlarged in pregnancy, Lange noted that in twenty out of twenty-two cases in which this hypertrophy was absent there was albuminuria; he observed that thyroidin given to pregnant women in whom hypertrophy had occurred caused diminution in the size of the gland; diminution in size also followed the administration of thyroidin in a case in which there was pathological enlargement of the gland; and he found that iodothyryn, given to patients suffering from the nephritis of pregnancy, was productive of diuresis, although the albuminuria was not much lessened. These observations led Oliphant Nicholson, in October 1900, to test the effect of thyroid extract in eclampsia (*Trans. Edin. Obstet. Soc.*, xxvi. p. 188, 1900-1), in one case under the care of Elmslie Henderson, and in another in the Edinburgh Royal Maternity Hospital, under Ballantyne; later, Nicholson reported four additional instances (*Trans. Edin. Obstet. Soc.*, xxvii. p. 160, 1901-2), and since then has discussed on several occasions the theoretical aspects of the subject, and given details of other cases similarly treated (*ibid.*, xxviii. p. 84, 1902-3; xxix. p. 50, 1903-4; xxxi. p. 213, 1905-6; *Edin. Med. Journ.*, N. S., ii. p. 456, 1909). This theory proceeds on the assumptions that there is always a toxæmia in pregnancy (the result of foetal metabolism); that this state is more marked towards the close of gestation (causing increased blood-tension and cardiac hypertrophy); that errors of diet, etc., may at any time so increase the toxic condition as to cause convulsions; and that, although the toxæmia is constant, the toxic agent causing the convulsions may differ, and (for this is the part in which this theory stands apart from others) may in some instances be produced by thyroid inadequacy. So long as the kidneys are able to



eliminate the toxins no grave symptoms will result, but any checking (especially a sudden one) of the renal functions will produce evil consequences. Nicholson discussed the pre-eclamptic signs and symptoms (œdema, albuminuria, diminished secretion of urine, high arterial tension, headache, eye conditions, diarrhœa, and muscular twitchings), and maintained that they were all capable of explanation by the theory of thyroid inadequacy. He thought, also, that through defect of the thyroid secretion the action of the suprarenal glands might be permitted to become excessive, leading to constriction of arterioles (especially those of the kidney) and increased blood-pressure, that the formation of urea ("the most powerful diuretic substance with which we are acquainted") would be diminished and the quantity of urine be lessened, and that the liver, being unable to cope with the untransformed proteids sent to it, would also become inadequate. These factors would combine to produce eclampsia. In a later article (1902), Nicholson introduced inadequacy of the parathyroids as well as of the thyroid gland into his scheme of pathogenesis. For the treatment of eclampsia and the pre-eclamptic state he therefore recommended and practised the use of thyroid extract alone or in combination with morphia; the morphia was employed for its immediate effect in checking the convulsions, and was given in a dose of half a grain (repeated once or even twice) hypodermically, and the thyroid could be administered before the convulsions or between them (if the patient were able to swallow), or it might be given, as the liquor thyroidei, by the hypodermic needle, or dissolved in saline solution (Macnab, *Journ. Obstet. and Gynæc. Brit. Emp.*, vi. p. 386, 1904). Nicholson recommended that the dose of the thyroid extract should be large, and the drug continued till symptoms of thyroidism appeared (30 to 60 grs. at a time, *Trans. Edin. Obstet. Soc.*, xxxi. p. 229, 1906). To a patient under the care of Ballantyne, in the Edinburgh Royal Maternity Hospital, Nicholson gave as much as 100 grs. within twelve hours; it was a serious case of eclampsia, and recovery followed, but a transient attack of hemiplegia was noticed on the eleventh day after the occurrence of the eclamptic fits.

It is difficult to judge if the giving of thyroid extract has greatly benefited cases of eclampsia or no. In Sturmer's series of 41 cases (*Journ. Obstet. and Gynæc. Brit. Emp.*, v. p. 531, 1904) at Madras, the mortality was reduced to 12·2 per cent. for the mothers, and 27 of the infants were alive at birth, although 8 of them died within 3 days (54 per cent. infantile mortality). Baldovsky's 2 cases (*Vrach Gaz.*, xi. p. 31, 1904) recovered. The remedy would appear to be most beneficial in those cases in which there is hard œdema, and those in which there is a myxœdematous or pseudo-myxœdematous condition; at any rate, clinical evidence shows that the drug may be safely given, even in large doses, in cases of eclampsia, and that it may also be administered for prolonged periods during pregnancy. Latterly, the question has been complicated by the problem of the action of the parathyroids. Frommer (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiv. p. 748, 1906), for instance, has proven experimentally that removal of the parathyroid glands in non-pregnant rabbits and bitches has no effect on their health, but that when placental substance was placed in the abdomen death from tetany followed; further, removal of the parathyroids from pregnant bitches and rabbits caused eclamptic seizures and tetany. It is, however, to Vassale (*Arch. ital. de biol.*, xliii. p. 177, 1905) that we owe the parathyroid theory of the origin of eclampsia and its treat-



ment by paraganglin or parathyroidin (Bellotti, *Gaz. d. osp.*, xxviii. p. 91, 1907; Kaiser, *Zentralb. f. Gynäk.*, xxx. p. 1240, 1907). According to this theory, it is parathyroid insufficiency (congenital or from disease) which causes eclampsia, and in support thereof it has been found that removal of the parathyroids causes eclampsia in gravid bitches, and that this can be held in check by the administration of large doses of parathyroidin (Vassale, *Arch. ital. de biol.*, xlvi. p. 143, 1906-7). At the present time, therefore, the theory of thyroid inadequacy in eclampsia has become one of parathyroid inadequacy, and the administration of parathyroidin or paraganglin is tending to supplant that of thyroid extract. In this connection it may be stated that Chirié (*Obstétrique*, N. S., i. p. 247, 1908) has found hyperplasia of the suprarenal glands (cortex and medulla) in eclampsia and nephritis. The occurrence of hypertrophy of the *fœtal* thyroid in Fothergill's case of maternal eclampsia following the administration of thyroidin (*Trans. Edin. Obstet. Soc.*, xxix. p. 41, 1903-4) may possibly be found to be of significance in connection with the pathogenesis of this grave complication of pregnancy.

*Theory of Placental or Chorionic Origin*—The idea that eclampsia is caused or at any rate precipitated by the passages of poisonous materials from the foetus to the mother is not new; but it has always been rendered difficult of acceptance by the occurrence of convulsions in the puerperium after the influence of the infant has been removed. This difficulty exists also in regard to the more recent views of a placental or syncytial origin for eclampsia, although the occurrence of cases in which convulsions accompanied a vesicular mole (*e.g.* Hitschmann's observation in the *Zentralb. f. Gynäk.*, xxviii. p. 1089, 1904), where, of course, there was no foetus but where there was a great proliferation of syncytium, is in favour of the latter theory. Liepmann (*Münch. med. Wochensch.*, lii. p. 2484, 1905; *Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 366, 1905, and lvi. p. 232, 1905) supported this view, and stated that a solution made from the placentas of eclamptic patients had a toxic character; he believed that the toxine, which was very labile, was fixed in the protoplasm of the cells of the placenta, and that it was absent from the normal placenta; he was also of opinion that the fewer the fits which occurred the greater was the amount of toxine in the placenta, and that, conversely, the more numerous were the fits the less toxine was found in the placenta. He thought that the toxine had a special affinity for the cells of the brain which fixed it, neutralised it, and were paralysed by it; that it acted deleteriously on the renal and hepatic parenchyma, and that the lesions in these organs were, therefore, secondary to the toxæmia, and that the epithelium of the chorionic part of the placenta appeared to play an important part in forming the toxine. Liepmann surmounted the difficulty of the puerperal cases by supposing that the liver might temporarily store up the toxine during pregnancy and labour to liberate it later (*Zentralb. f. Gynäk.*, xxx. p. 693, 1906). His reason for not accepting the theory that the foetus was the source of the toxine was the fact that the child itself was so seldom injured by it. Before Liepmann's observations were published, Koenig (*Zentralb. f. Gynäk.*, xxvii. p. 1175, 1903) had pointed out the occasional association of eclampsia and large placenta (with a relatively small infant); but this fact cannot be freely used in support of the theory of placental origin, for the large size might be due to syphilis. Dienst (*Zentralb. f. Gynäk.*, xxix. p. 353, 1905) regarded the causal factor in



eclampsia as the mixing of the foetal and maternal blood, for he found that the placenta in such cases was more permeable, and he thought that blood from the foetus acted upon that of the mother like the blood of a distinct species. In support of his views, Dienst discovered that blood obtained by venesection from two cases of albuminuria, when tested upon normal blood, caused agglutination and hæmolysis; after delivery, the maternal blood was tested upon that of the infants for agglutination, with a positive result. A special development of the theory of the placental origin of eclampsia is expressed in the statement that there is a deportation of villi or parts of villi from the placenta into the mother's blood. Labhardt (*Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 264, 1905) discussed this view and its modifications, grouping them into three classes—(1) Schmorl thought that placental cells passed into the maternal circulation, and, placing this idea in conjunction with Ehrlich's demonstration that the entrance of foreign cells into an organism caused chemical changes, and with Veit's belief that the placental cells produced a poison in the mother, considered that the poison thus carried over caused eclampsia, and that as only a few cells were deported the amount of the poison was small and the disease rare; (2) Ascoli expanded this view, and stated that the foreign cells brought about the formation of new substances which dissolved them and neutralised their poisonous effects; these new substances were lysins (syncytiolysins), and, if they were formed in excess, they caused eclampsia; (3) Weichardt, again, thought that by the solution of the placental cells a new poison was formed (syncytiotoxine), which was usually neutralised by an antitoxine, and that if the latter failed to be formed in sufficient amount, the syncytiotoxine caused the eclamptic seizures. Labhardt (*loc. cit.*) criticised these views, pointing out that deportation of villi was frequent, whilst eclampsia was rare; that the placental cells were hardly "foreign" to the maternal organism; that eclampsia was very rare in animals that possessed placentas; and that the frequency of eclampsia in primiparæ, in cases of flat pelvis and hydramnios, and in certain places at certain times, could not be accounted for by this theory. He added that its non-occurrence in cases of tubal abortion was a mystery. The examination of ectopic pregnancies has still further weakened the placental theory of origin of eclampsia, for it has shown that the appearances described as deportation of villi may possibly be due to decidual reaction and formation in the walls of blood-vessels in the Fallopian tube (see ECTOPIC PREGNANCY, TUBAL, p. 169). Whilst it cannot be affirmed that the placental theory of origin of eclampsia has been fully established, it may at any rate be stated that truth in large or small measure is contained in it. Eclampsia does not occur without pregnancy; it occurs most often in women who are for the first time experiencing the metabolic changes produced by uterogestation, the great biological link between the mother and her foetus is the placenta, and the theory founded upon placental conditions fulfils the requirements of modern views on the pathogenesis of toxæmia. There is always danger of concentrating our attention too much upon a detail (*e.g.* lacticaciduria as developed by Zweifel (*Arch. f. Gynaek.*, lxxvi. p. 537, 1905; Füh and Lockemann, *Zentralb. f. Gynäk.*, xxx. p. 41, 1906), and forgetting the great generalisation that eclampsia is due to a toxæmia. In time it may be possible to differentiate various types of eclampsia, and a placental variety, a thyroïdal variety, an intestinal variety, and so on, may be recognised and separated and



treated along lines peculiar to each; meanwhile, the safest procedure to be adopted must be to treat the disease as a toxæmia and on the general principles which have proved to be most beneficial.

METHODS OF TREATMENT, OLD AND NEW.—Turning now to treatment, we find the same divergence of opinion still prevailing as was noticeable at the end of the nineteenth century. Veit's morphine treatment is still popular with some obstetricians (Harpe, *Journ. Obstet. and Gynec. Brit. Emp.*, ix. p. 102, 1906), but Bumm and others have declared against it. Chloroform and chloral are still extensively used, but it has been found that the administration of chloral by the rectum (the usual plan) is uncertain, and that it is better to give it by the mouth, the stomach having been previously washed out; chloral has been given hypodermically (Ballantyne, *Trans. Edin. Obstet. Soc.*, xxxiii. p. 43, 1907-8), but this requires caution. In America the treatment by hypodermic injections of the tincture of veratrum viride is yet in vogue, but apparently it is less popular; the drug is given till the pulse-rate falls to 60. It may be, however, that the reduction of the blood-tension produced by veratrum is itself dangerous, and hence it has become customary to combine its administration with that of camphor or caffeine. In Europe, Mirto (*Ann. di ostet. e ginec.*, ii. for 1905, p. 580) and others have spoken highly of the value of veratrum viride. Venesection and the injection of saline solution under the breasts or into the veins has been highly reported upon, and Jardine put on record fifteen cases of eclampsia with no maternal deaths treated by the above means, combined with free purgation and the use of hot packs (*Journ. Obstet. and Gynec. Brit. Emp.*, viii. p. 14, 1905). Budin (*Rev. gén. de clin. et de therap.*, xxi. p. 101, 1907) emphasised the immense importance of clearing out the intestine both for the prevention and treatment of eclampsia; rectal washing and bleeding were strongly recommended by him. The use of nitroglycerin internally or by hypodermic injection has been highly spoken of (McCarthy, *Brit. Med. Journ.*, i. for 1908, p. 1220). Hot packs have been freely employed by some, while others dread their effect in concentrating the blood and so increasing the amount of toxins in it. The use of thyroid extract and of paraganglin has been already touched upon (*vide antea*, p. 157). The difficulty of coming to any conclusion among all these methods depends on the varying circumstances: sometimes and in some places the disease appears to be milder than in others; seldom does the obstetrician confine himself strictly to any one line of treatment, but uses several in conjunction, and may even employ two or more which are pharmacologically incompatible; little or no attempt is made to differentiate types of eclampsia and treat differently in accordance with the clinical variety which is presently being dealt with; and to some extent prejudice and the usage of different schools of obstetrics have hindered the formation of unbiassed opinion.

Standing somewhat apart from the various methods of management referred to above are the obstetric treatment and the preventive treatment of eclampsia. With regard to the former, which generally means *rapid emptying of the uterus*, there is still a very clearly defined difference of opinion. Those, who perhaps represent the obstetricians of the past, who maintained that "meddlesome midwifery is bad," cry out against operative interference to terminate labour; these, who perhaps take the place to-day of the men whose watchword was "delays are dangerous," are insistent upon the necessity of removing from the



interior of the uterus the foetus and the placenta, one or both of which they regard as the causal factor in the production of the convulsions. Much has been said and written on both sides during the past five or six years (*vide*, for instance, the discussion in the *Brit. Med. Journ.*, 23rd September 1905), but the general impression left on the mind after a careful reading of the literature of the subject (great in amount and of varying value) is that, on the whole, those who advocate early emptying of the uterus and who employ the safest methods of doing so have achieved results which compare favourably with those obtained by others who pursue more conservative methods. Bumm's statistics as quoted by Liepmann (*Münch. med. Wochensch.*, lii. p. 2484, 1905) and by Bumm himself (*Deutsche med. Wochensch.*, xxxiii. p. 1945, 1907), although they have been attacked by Hastings Tweedy (*Journ. Obstet. and Gynec. Brit. Emp.*, x. p. 106, 1906), are strikingly in favour of early operative interference; and Osterloh (*Münch. med. Wochensch.*, lv. p. 553, 1908) at Dresden, and Esch (*Zeitsch. f. Geburtsh. u. Gynäk.*, lviii. p. 11, 1906) for the Olshausen Clinique at Berlin, are agreed in recommending immediate termination of all the cases of eclampsia in which there is marked disturbance of the general condition (coma, fever, rapid pulse, etc.). At the same time, the other side has constantly to be heard, and it cannot be said that this matter is definitely decided; evidence is still being led.

If, however, the obstetrician have decided to terminate labour quickly, it may be asked whether the obstetric advances of the past six or seven years have furnished him with any better methods of rapidly emptying the uterus than he possessed in the nineteenth century. Let us look first at *Bossi's metallic dilator* (with its modifications by Frommer and others), which was introduced in Italy during the last decade of the past century. In eight cases of complicated labour (in three of which eclampsia formed the complication) Ballantyne employed Bossi's dilator, and all the three mothers recovered (*Trans. Edin. Obstet. Soc.*, xxix. p. 76, 1903-4); at the same time he regarded it as an exceptional method, to be employed in exceptional cases, and did not minimise its dangers. It was about this time that dilatation of the cervix with the Bossi instrument and others of similar type was being most often performed, if we may judge by the literature of the subject, and among many articles we may name those of Cocq (*Bull. soc. belge de gynec. et d'obstét.*, xiv. p. 116, 1903-4), Hartz (*Monatssch. f. Geburtsh. u. Gynäk.*, xix. p. 91, 1904), de Seigneux (*Arch. f. Gynaek.*, lxx. p. 614, 1903), Bossi (*Arch. ital. di ginec.*, vii. p. 60, 1904), Ricci (*ibid.*, p. 71), Armstrong (*Brit. Med. Journ.*, i. for 1904, p. 717), Kerr (*Glasgow Med. Journ.*, lxi. p. 169, 1904), Hahl (*Arch. f. Gynaek.*, lxxi. p. 509, 1904), Nubiola (*Rev. de med. y cirug.*, xviii. p. 241, 1904), F. Montuoro (*Il taglio cesareo ed il parto forzato* (Genova), 1904), and Frommer (*Zentralb. f. Gynäk.*, xxviii. p. 1017, 1904). From this time onward we hear less of metallic dilators in eclampsia and more of cutting operations (*vide infra*). In 1905, for instance, we find Hamerschlag (*Zeitsch. f. Geburtsh. u. Gynäk.*, lvi. p. 351, 1905), after an experience of twenty-five cases, stating that Bossi's dilator should only be used by the specialist; and Holdich Leicester (*Journ. Obstet. and Gynec. Brit. Emp.*, xi. p. 230, 1907) thought it should be employed only by those accustomed to perform major obstetrical operations. Weber, however (*Arch. f. Gynaek.*, lxxxii. p. 717, 1907), and Keyserlingk (*Zentralb. f. Gynäk.*, xxxi. p. 711, 1907) still prefer Bossi's method to Dührssen's incisions and vaginal Cæsarean section. It must be admitted that in



cases in which the cervix is not taken up its use is attended by grave danger of serious cervical lacerations; it finds, therefore, its most distinct indication in the cases in which the cervix is undilated, but in the shape of a ring.

During the past few years a good deal has been written in favour of *vaginal section* (the so-called vaginal Cæsarean section) as a means of rapidly emptying the uterus in serious cases of eclampsia. With the patient in the lithotomy position, the operator exposes the cervix (with a speculum) and draws it down to the vulva (with volsellæ). If (as is often the case) the patient be a primipara, with a narrow vulva and vagina, it may be well to do an episiotomy at once, in order to give room. An incision is then made through the mucous membrane of the anterior lip of the cervix and the anterior vaginal wall of an inverted T (⊥) shape. The bladder is now separated from the cervix by the fingers or by the handle of the knife until the peritoneum of the utero-vesical pouch comes into the view; the latter is not incised. The cervix is next split in the middle line with scissors, pulled further down with the volsellæ, and the incision (four inches long) is carried further up into the lower uterine segment. If the operation be performed near the full term it will be well to incise the posterior as well as the anterior lip of the cervix. Bleeding is controlled during the making of the incisions by downward traction upon the cervix. The delivery of the infant is now rapidly accomplished, the placenta removed, and the uterus massaged and sometimes packed with gauze. The incisions in the cervix are closed with sutures (continuous or interrupted catgut) placed near together; the posterior incision (when present) is closed first. Care must be taken that the sutures do not catch in the gauze packing. The vaginal incision is closed by a continuous catgut suture, and the perineum is repaired if a preliminary episiotomy has been performed. Carstens, in 1904 (*Amer. Journ. Obstet.*, l. p. 633, 1904), spoke very favourably of this operation, and affirmed that it could be performed by any general practitioner; but Zinke (*ibid.*) doubted this, and, as a matter of fact, vaginal section is more difficult of performance than a reading of the descriptions given in text-books would lead us to expect, for it must not be forgotten that the anatomical relations of parts are considerably altered in late pregnancy. Fry (*Surg. Gynec. and Obstet.*, i. p. 58, 1905) emphasised the short time (10 minutes) required to remove the child by the vaginal section, and reported a case of eclampsia at the sixth month successfully treated by this means. Hammerschlag (*Zeitsch. f. Geburtsh. u. Gynäk.*, lvi. p. 351, 1905) regarded it as an excellent operation, involving only slight injury and danger, and Keyserlingk (*Zentralb. f. Gynäk.*, xxxi. p. 711, 1907), Büttner (*Beitr. z. Geburtsh. u. Gynaek.*, xi. p. 401, 1907) and Weisswange (*Zentralb. f. Gynäk.*, xxxii. p. 337, 1908) have all written favourably of it, and described cases in which it was used. Bumm's recent statistics give forty consecutive cases of eclampsia thus treated with one death, whilst Veit has had thirty-three cases with one death. If it be admitted that rapid delivery is *the* treatment in serious eclampsia, then vaginal Cæsarean section will be the operation of choice in the very instances in which Bossi's dilator is contra-indicated, viz. those occurring early in pregnancy, with an undilated cervix, not yet taken up. A recent paper on the subject is that by Humpstone (*Amer. Journ. Obstet.*, lix. p. 92, 1909), who reports five cases (none of them in labour) thus treated, with one maternal death. A somewhat extraordinary case was reported by Boldt in 1905 (*Post-Graduate*, xx. p. 1251,



1905), in which ordinary Cæsarean section was performed upon a girl, twelve years and eight months old, who had a small pelvis and severe eclampsia; but, as a general rule, the ordinary operation has been very seldom employed in cases of convulsions, and where it has been done the mortality was high. Digital dilatation and dilatation by means of the Champetier de Ribes's bag are still occasionally used in eclampsia for rapid evacuation of the uterus, but Bossi's dilator and the vaginal Cæsarean section are more in evidence.

Quite apart from operative dilatation of the cervix two other surgical procedures have found advocates within the past few years, viz. *lumbar puncture* and *renal decapsulation*. The former, perhaps, can hardly be called surgical, for it is an extremely simple operation. Helme of Manchester used this method in December 1903 (*Brit. Med. Journ.*, i. for 1904, p. 1131) in a typically severe case of eclampsia in which saline injections, thyroid extract, and chloral had previously been given; he noted that the cerebro-spinal fluid escaped as if under considerable pressure; the patient recovered. The theory which was advanced to explain the mode of action of lumbar puncture was very simple. It was taken for granted that the convulsions were due to increased cerebro-spinal tension; therefore, if some of the fluid was removed by puncture of the arachnoid space, it was concluded that the tension would be reduced and the fits would for the time cease; the interval of freedom from fits could be utilised for the application of other forms of treatment, which would effectually and permanently remove the cause of the high tension. Three cases treated by lumbar puncture by Krönig also recovered (*Zentralb. f. Gynäk.*, xxviii. p. 1153, 1904), but out of sixteen cases dealt with by Max Henkel four terminated fatally (*ibid.*, xxviii. p. 1329, 1904). In a grave case of eclampsia treated by lumbar puncture, Ballantyne noticed that the spinal fluid did not escape freely from the needle, but rather oozed out drop by drop; it was a fatal case (*Trans. Edin. Obstet. Soc.*, xxx. p. 132, 1904-5). Proud (*Brit. Med. Journ.*, i. for 1906, p. 678) reported two successful cases, and Jardine used lumbar puncture along with other means, in an extraordinary case in which there were over 200 fits, with ultimate recovery (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 38, 1906). Mirto (*Ann. di ostet. e ginec.*, ii. for 1905, p. 580) did not find lumbar puncture to be founded on a solid basis of theory; and, certainly, little has been heard of the plan during the past two years, although Audebert and Fournier (*Compt. rend. soc. d'obstét. de gynéc. et de pédiat. de Paris*, ix. p. 119, 1907; *Ann. de gynéc. et d'obstét.*, 2 s., iv. p. 350, 1907) have reported two cases, one of which recovered, and the other died.

*Renal decapsulation* is the most recently suggested means of combating eclampsia, and already a considerable literature has gathered round it. It was introduced by Edebohls in 1903 (*Amer. Journ. Obstet.*, xlvii. p. 783, 1903; l. p. 260, 1904), and was, soon afterwards, recommended by Sippel (*Zentralb. f. Gynäk.*, xxviii. p. 479, 1904). The view that is held regarding this surgical procedure in cases of puerperal eclampsia must depend largely upon its success in nephritis unaccompanied by pregnancy; and it must be owned that neither experimental evidence (such as that provided by Rondoni, *Policlín.*, xiv., sez. chir., p. 40, 1907) nor clinical experience have absolutely established its value in the latter condition. But it may be maintained that pregnancy-kidney is very different from ordinary nephritis, and that eclampsia is not necessarily uræmia, and that renal decapsulation may serve in a special way to meet



some of the indications peculiar to the former morbid state. It is necessary, therefore, to judge by the results obtained in eclampsia alone. Now, E. Kehrer of Heidelberg has collected together (*Zeitsch. f. Gynäk. Urologie*, i. p. 111, 1908) the records of twenty-three cases, in which Edebohls's operation of renal decapsulation was performed; eight patients died, giving a mortality of 34·7 per cent., although in three of the fatal cases the death was due to complications (broncho-pneumonia, bleeding from a gastric ulcer, and late infection of the wound). In most of the instances cited the operation was performed some hours or some days post-partum, but in two it was done during pregnancy. In the two last named it was successful, in one of them vaginal Cæsarean section being also carried out. Edebohls himself, the introducer of the operation into this sphere of obstetric practice, had done decapsulation in three cases, in all of which it was successful; Wiemer also had operated thrice, with one death on the thirteenth day from infection of the operation wound (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 321, 1908). It is doubtful whether the principles on which this operation proceeds are correct; it is also doubtful whether the death-rate can be used as a strong argument against its employment, for the records show that it was in many instances only after all other means of treatment had failed that renal decapsulation or incision was tried. In future its use will probably be restricted to those grave cases of eclampsia in which the renal element is markedly present (*e.g.* as shown by anuria), and in which, in spite of emptying the uterus, and in spite of employing all the other means of stimulating the excretory organs, the convulsions are becoming stronger, and the general condition getting worse. These indications were present, for instance, in the successful case reported by Sir Halliday Croom (*Edin. Med. Journ.*, N. S., ii. p. 443, 1909). Under these circumstances, Edebohls's operation, if contemplated, should not be delayed more than a few hours. Bumm considers that this operative procedure should be reserved for the puerperium, and certainly it has been most often employed then; Pinard, also, would strictly limit its sphere of application (*Ann. de gynéc. et d'obstét.*, 2 s., iii. p. 193, 1906). It is noteworthy that the condition of the kidney itself found at the time of operation differed considerably; in some cases it was tense, and protruded at once through the divided capsule, but in others it was soft and sodden (Runge, *Berl. klin. Wochensh.*, xlv. p. 2068, 1908). As a result of the decapsulation it is commonly found that there is an increase in the flow of urine and in the excretion of urea, usually at once, but sometimes only after several hours; in this way the toxins will be got rid off more quickly. Other explanations have been advanced, such as the formation of anastomoses between the surface of the kidney and the fatty capsule, but these have not been supported by actual demonstration, and it is probable that the physiological effect described above is the only one about which we can be certain. At the time of writing, the value of renal decapsulation, with or without renal incision, must be regarded as not accurately defined; but, granted its value, the indications for its employment are very different from those guiding us in having recourse to vaginal Cæsarean section. Vaginal section finds its chief indication in eclampsia occurring about the fifth or sixth month of pregnancy, with a cervix undilated and not taken up; renal decapsulation, on the other hand, is to be thought of preferably in the puerperium, when it is clear that the emptying of the uterus has not succeeded in arresting the eclampsia. Between these two methods, with their relative indications, are the



cases calling for the use of the Bossi dilator or other form of cervical distension.

Whatever may be the form of operative interference found most suitable in cases of eclampsia, prevention will ever be the most satisfactory method of treatment. Indeed, it may be said that the *prevention of eclampsia* is the one bright spot in a gloomy sky at the present time. Of course it is difficult to establish a claim in many cases, for we are met with the objection that in them eclampsia would not have occurred even if no preventive measures had been taken; but every obstetrician of experience must have noticed that cases of albuminuria in pregnancy brought under treatment before the onset of labour very often pass through their confinements without eclampsia, and that even if fits occur they are seldom many or severe. It is admitted by all (and it is something to be able to say this in connection with eclampsia, in which, as Evans has said (*Brit. Med. Journ.*, ii. for 1906, p. 1205), there "is not a drug used nor a procedure employed on theoretical grounds, or as a result of experience, that has not as many enemies as friends")—it is admitted by all that albuminuria in pregnancy often precedes eclampsia, and that if the former be early recognised and promptly treated the latter can very often, almost always, be prevented; there is also a consensus of opinion that a rigid milk diet, regular daily evacuation of the bowels, the avoidance of chilling of the surface of the body, and the cautious use of diuretics will act most beneficially on the albuminuria of pregnancy; and the reasonable conclusions to be drawn are the systematic examination of the urine in pregnancy and the immediate treatment of the patient on the appearance of the slightest trace of albumin therein. To the general practitioner with a large number of midwifery cases these precautions may seem irksome, and in many instances unnecessary, but they form the sound basis of the rational treatment of eclampsia, and he will soon be convinced, if he have to treat some four or five cases of eclampsia, that the time and care spent in carrying out precautionary measures are far less than those needed successfully to manage one single case of convulsions in labour or the puerperium. When in addition to the presence of albumin there is marked diminution in the quantity of urine passed, a fall in the quantity of urea secreted, the presence of tube casts or blood, and a state of high tension of the pulse, it is doubtful whether it is not already too late to prevent the occurrence of eclampsia; but even then prophylaxis may accomplish much. To the staff of a maternity hospital the prevention of eclampsia is a matter of even greater importance than to the general practitioner. Every maternity hospital ought to have a pre-maternity department or ward or pavilion set apart exclusively for the treatment of the diseases of pregnancy (Ballantyne, *Brit. Med. Journ.*, i. for 1901, p. 813; i. for 1902, p. 65; *Trans. Edin. Obstet. Soc.*, xxxiii. p. 25, 1907-8; *Journ. Obstet. and Gynæc. Brit. Emp.*, xv. pp. 93, 169, 1909), and an out-patient clinique to which pregnant women should be invited to come for purposes of diagnosis, and through which admission to the pre-maternity ward might, if necessary, be obtained. In an editorial published in the *Lancet* of 2nd November 1901, the following sentences occurred:—"We are inclined to think that if a correct knowledge of the causation of eclampsia is ever to be arrived at, attention must be directed to the pre-eclamptic stages of the disease. It is an encouraging sign to see that . . . a bed is to be endowed and set apart for the study of the



diseases of pregnancy in the Royal Maternity Hospital of Edinburgh. We can imagine no more worthy object for philanthropy than the endowment of such beds in some of our large maternity hospitals, where the diseases of pregnancy and of the unborn child could be investigated with all the advantages of modern science." The bed in the above hospital is now a ward, and Ballantyne was able to report that in his quarter in 1908 none of the cases of albuminuria in pregnancy treated in that ward developed eclampsia, and that all the patients (five in number) which were brought into the ward suffering from eclampsia, and which were treated therein for some days before labour supervened, recovered (*Journ. Obstet. and Gynec. Brit. Emp.*, xv. pp. 98, 104, 1909). In such wards the early indications of the toxæmia of pregnancy could be recognised and treated; in this way the grave forms of toxæmia could be almost certainly prevented, or, at any rate, so reduced in virulence as not to pass on into eclampsias. Boxall (*Brit. Med. Journ.*, ii. for 1905, p. 717) thinks that every maternity hospital ought not only to have a pre-maternity ward but also "a department where women who are able to work either in the house or garden attached to the institution could be kept under observation for two or three months prior to delivery"; but it is possibly too much to expect so radical a change to occur, and so increased a responsibility to be undertaken by maternity charities in the near future. It may be said, in conclusion, that the most hopeful aspect of eclampsia at present is undoubtedly prevention; the toxæmia of gestation need not occur in a grave form in a well-watched pregnancy, and even if it occur it can nearly always be prevented from culminating in eclampsia if suitable dietetic and therapeutic means be employed early and energetically. Until such time as a certain means of checking and curing eclampsia be discovered, our watchword must, of necessity, be "prevention."

**Eclampsism.**—The term "eclampsism" (or "eclampsia sans accès") has been proposed by Paul Bar (*Rev. mens. de gynéc. d'obstét. et de pédiat.*, iii. p. 41, 1908) for the group of signs and symptoms which indicate that an attack of eclampsia is imminent. These are—(1) a persistent decrease in the amount of urine passed; (2) a diminution in the percentage of chlorides contained in the urine; (3) the development of slight or of more marked œdema; (4) albuminuria, especially if the albumen be associated with albumoses, with peptones, and with acetosoluble albumen; and (5) urobilinuria and slight jaundice. The signs and symptoms which have been named may exist for some time without convulsive seizures actually occurring; but if, in addition, there be arterial high tension, amblyopia, severe headache, epigastric pain, dyspnoea, ringing in the ears, and sudden paralysis of groups of muscles, the supervention of eclamptic seizures is imminent. Now, in a few cases eclampsism is present without eclampsia following it; or, rather, it is sometimes followed by a condition known as "eclampsia without convulsions," and this may prove fatal, with post-mortem lesions similar to those found in fatal cases of ordinary eclampsia. For example, a patient with eclampsism may pass into a state of coma without the occurrence of convulsions, or she may have very grave dyspnoea, or severe trigeminal neuralgia, or a hallucination. Bar regarded these symptoms as equivalent to the more commonly observed convulsive seizures. It might be suggested that this morbid state, called by the Germans "Eclampsie ohne Krämpfe" or "status eclampticus," is



really uræmia, were it not that the post-mortem examination reveals the lesions peculiar to eclampsia (Schmorl, *Münch. med. Wochensch.*, lv. p. 363, 1908; Schlutius, *Zentralb. f. Gynäk.*, xxxi. p. 107, 1907). The treatment of eclampsia is that which has already been called the preventive treatment of eclampsia, and Bar was of opinion that if it were not very soon followed by the disappearance of the signs of toxæmia, the induction of labour was indicated, and that this was specially to be recommended in the irregular cases of *eclampsia sine convulsionibus*. In addition to the articles already named, the references of the following are added:—Binder, *Zentralb. f. Gynäk.*, xxx. p. 1017, 1906; Esch, *ibid.*, xxx. p. 295, 1906; Gaillard, *Tribune méd.*, N. S., xxxix. p. 629, 1907; Reinecke, *Münch. med. Wochensch.*, liv. p. 1522, 1907; Slemons, *Johns Hopkins Hosp. Bull.*, xviii. p. 448, 1907; Brunet, *Münch. med. Wochensch.*, lv. p. 702, 1908, and *Gynæk. Rundschau*, ii. p. 177, 1908; Chirié and Stern, *Bull. soc. d'obstét. de Paris*, xi. p. 19, 1908, and *Tribune méd.*, N. S., xl. p. 261, 1908; and Daunay, *Bull. soc. d'obstét. de Paris*, xi. p. 317, 1908.

## Ectopic Pregnancy.

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### TUBAL PREGNANCY.

At the beginning of the twentieth century the investigation of the causes and method of implantation of the fertilised ovum in the Fallopian tube had reached a stage beyond which it could scarcely pass until there was an increase in our knowledge of the details of the embedding of the ovum on the endometrium; in other words, the elucidation of the pathology of tubal pregnancy had to wait upon the discovery of the exact mode of commencement of normal uterine pregnancy. As it so happened, the publication of Leopold's (1897), Peters's (1899), von Spee's (1905), Teacher-Bryce's (1908), and Jung's (1908) *Ova* was most opportune, and did much to settle the latter question and make possible the better understanding of the former. The settlement of the problem is not of purely academic interest; the carrying out the details of operative interference depends, in a large measure, upon it; it may mean the saving or losing of a life, maternal especially, but also foetal.

The *first* question in this problem is concerned with decidual reaction. In an ordinary intra-uterine pregnancy decidual changes are found in a very marked degree in the endometrium, sometimes in the cervix, and very rarely (almost never) in the tube, the ovary, and the peritoneum. These decidual changes consist in enlargement of the stroma cells of the endometrium until they become epithelioid in appearance (the cells enlarge more than the nuclei and come to contain glycogen), in the widening of the lumen of the glands, in the proliferation of their lining epithelium, and in the taking on of a more cubical character by the epithelial cells. All the evidence goes to show that true decidual cells are not formed in the uterus save in connection



with pregnancy, although what may be called decidua-like cells may appear. It is, however, a difficult matter to separate true decidual cells from the cells of Langhans's layer. The following characters will be helpful:—Langhans's cells are generally polyhedral, and are closely packed together; decidual cells are more rounded or oval, and generally show intercellular tissue; the former contain a clearer (less easily stained) protoplasm, with a fine network in it, while the protoplasm in the latter stains better, is granular, and shows no network or only a very fine one; the cell outlines in the former are clear, in the latter less distinct; and, finally, the nuclei of Langhans's cells are larger than those of decidual cells, they have a bladder-like appearance which those of decidual cells do not have till later, and they have a marked chromatin network and nucleolus. It is of great importance to keep these differences in mind when examining the histology of tubes which are the site of ectopic pregnancy, for it is quite evident that in the past Langhans's cells have been mistaken for decidual ones, in other words, foetal trophoblast cells have been confused with maternal decidual ones. Another matter of some interest has emerged—the fact that early intra-uterine pregnancies have shown that decidual formation follows and does not precede the implantation of the ovum on the mucous membrane: from this, it must be concluded that it is not essential for an ovum to be embedded on pre-existing decidual tissue.

With these facts in mind we are better able to consider the question of decidual reaction and formation in connection with tubal pregnancy. Here, as in normal pregnancy, the formation of decidual cells has been looked for in the uterine mucous membrane, in the tubes, in the ovaries, and in the neighbouring peritoneum. As it is of most importance, the change in the tubes may be considered first. It would appear that, while individual observers differ as to its amount, all are agreed that there is some evidence of decidual reaction in the mucous membrane of the tube which contains the fertilised ovum. Occasionally traces of the same have been noted in the mucosa of the empty tube. As a rule the decidual reaction is slight, being, however, more marked in the folds than in the spaces between the folds. The small degree of change is probably due to the absence of anything resembling the thick mucous membrane of the body of the uterus; indeed, the tubal mucosa is hardly fitted anatomically for the growing of a decidua, at any rate it does not furnish the elements for the compact layer of the same. Conflicting statements have been made regarding decidual changes in the sub-mucous and intermuscular tissues of the tube which enter into the formation of the gestation sac; it is in this relation that great care has to be taken to distinguish between true decidual (maternal) cells and the decidua-like (foetal) cells of Langhans's layer of the trophoblast; and there can be no doubt that in some cases Langhans's cells have been regarded as decidual, and this remark applies specially to the tissue which has been described as tubal decidua serotina or basalis. Recent observations seem to show, however, that decidual changes take place in the walls of the blood-vessels of the pregnant tube, occasionally in the endothelium, but more constantly in the tunica intima. The decidual cells formed in the vessels require to be carefully distinguished from Langhans's cells, as can usually be done by keeping the characteristic features (enumerated above) in mind. The appearance which has been described as deportation of Langhans's cells in veins is possibly to be regarded rather as formation of decidual cells in the walls of the



vessels. Decidual reaction in the case of the general peritoneum or of that covering the tube has been very rarely observed, but then it has not often been looked for. In Penkert's case (*Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 88, 1905), a tubo-abdominal one, chorionic villi were found attached to the omentum, and in the latter there were clumps of typical decidual cells; and similar cells were found in the peritoneum of the appendix vermiformis in a case in which that structure was adherent to the pregnant Fallopian tube of the right side, the reporter (Hirschberg, *Arch. f. Gynaek.*, lxxiv. p. 620, 1904-5) naming the condition "periappendicitis decidualis." These reports, demonstrating the possibility of decidual reaction occurring in the peritoneum, make the case for primary abdominal pregnancy much stronger. Scarcely any observers have noticed decidual cells in the ovary in tubal pregnancy. To complete this survey of decidual reaction in tubal gestation, it must be added that the uterine mucous membrane almost always shows very distinct changes of the nature of the formation of a decidua, although considerable differences exist with regard to its extent, and to the time of its being shed.

The *second* question has reference to the relationship of the gestation sac to the wall of the tube; in this direction distinct progress has to be reported. It is necessary to abandon the view that the fertilised ovum is simply attached to the tubal mucosa, with a part projecting freely into the lumen of the tube. In at any rate the vast majority of cases the ovum is embedded in the tube wall; it is, in fact, submucous in position; it may appear to be in the lumen of the tube, but serial sections show that it is really under the mucous membrane, and that it is, indeed, generally intra-muscular. What has been called the decidua reflexa in tubal pregnancy probably is simply the tubal tissues and the trophoblast of the ovum; it ought to be regularly called the *capsularis*. That it is not decidua is proved by the presence of muscular fibres in it. It is very likely that as in the uterus so in the tube the fertilised ovum, by the action of its proliferating trophoblast, penetrates the epithelium of the mucous membrane; in the tube it further bores its way down into the muscular layer, an occurrence which is rare in uterine pregnancy, but not unknown although always pathological. Of course it is possible that the ovum may sometimes reach its deep position in the tube wall by entering a diverticulum, but this must be rare, and it is generally conceded that it is by destruction of maternal tissue that the trophoblast penetrates the tubal tissues and carries the ovum in amongst the muscular fibres. It is probably by the same action of the trophoblast upon the maternal blood-vessels that communication is established between the ovum and the blood of the mother. The so-called "deportation of villi," or of pieces of their epithelial covering, is, therefore, not only possible but probable in all pregnancies, whether intra- or extra-uterine; for it has been shown that the action of the trophoblast (especially Langhans's cells) in opening into maternal vessels is the method by which the ovum is brought into contact with the maternal blood in normal pregnancy. Decidual reaction in the vessel walls and the invasion of these walls with trophoblast cells are both regarded as common occurrences, and may be seen in the same tube wall (Schambacher, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlviii. p. 428, 1902-3). At the same time, great care has to be taken, in expressing an opinion on the subject, not to confuse Langhans's cells with true decidual ones. In connection with the embedding of the ovum in the tube wall, it is



more correct to speak of the destructive action of the trophoblast than of the villi, for the former has burrowing powers in its early stage when it consists simply of syncytium and Langhans's cellular layer, and before the mesoblast has, by sending projections into it, formed the villi. Further, with the disappearance of Langhans's cells about the sixth week, the destructive or pseudo-malignant action on the maternal structures probably ceases; the later developments of the gestation sac in the tube wall must thereafter be due to other factors. To sum up, it is probable that the phenomena of pregnancy in the tube wall, which differ from those met with in the uterine wall, are due not so much to any difference in the action of the trophoblast or villi upon the tissues of the tube, but rather to the nature and extent of the tissues of the wall; in the tube there is not the thick layer of mucous membrane which exists in the uterus, and connective tissue is scanty, so that the trophoblast comes into contact with and has to make its way into *muscle*.

The *third* question in the problem of tubal gestation relates to the cause and mode of rupture of the wall of the tube. The discovery of the submucous or intra-muscular position of the gestation sac in tubal pregnancy has thrown some light upon this question, and it brings two apparently different occurrences into line, viz. tubal rupture and tubal abortion. The latter is so important that a special paragraph is devoted to it (*vide infra*), but it may be stated here that the problem has been greatly simplified by the recognition of the fact that tubal abortion must necessarily be preceded by rupture, by *internal* rupture, of the gestation sac before the ovum can be free in the tubal lumen or find its way out of the tubal ostium. If internal rupture of the capsule of the sac do not occur, then *external* rupture may take place, or the wall of the tube may give way in such a position as to enable the ovum to pass between the layers of the broad ligament and become *intra-ligamentary*. To take the latter occurrence first, it may be said that the recent work done in this department seems to show that intra-ligamentary rupture is comparatively rare; but Andrews, in his admirable synopsis of the whole subject of tubal gestation (*Journ. Obstet. and Gynæc. Brit. Emp.*, iii. p. 419, 1903; ix. p. 469, 1906), is unable to assign any satisfactory explanation for this rarity. It may possibly be connected with an absence of decidual reaction in the connective tissue of the broad ligament, although this remains to be demonstrated. In respect of external rupture of the tube into the peritoneal cavity, various causes have been alleged. There can be very little doubt that traumatism (*e.g.* a bimanual examination under an anæsthetic) may effect it, and such a possibility must, of course, be borne in mind in connection with the diagnosis or attempted diagnosis of ectopic gestation. In most cases, however, it is not external but internal causes which lead to rupture. Of the causes inherent in the tube itself we may name the destructive action of the trophoblast of the ovum, the hæmorrhage into the tube wall, and contractions of the muscle of the tube. In early ruptures (*i.e.* those before or at the seventh week) the first-named factor (destructive or burrowing action of the trophoblast) would appear to be the common agent; it may act directly and cause perforation of the muscular and peritoneal coats of the tube, or it may lead to the rupture indirectly by causing perforation of a blood-vessel, effusion of blood, consequent stretching and final bursting of the tube. Later ruptures (after the seventh week) are probably to be ascribed more often to such



mechanical causes as stretching of the sac wall from hæmorrhage into it, aided or not by contractions of the tube itself, than to the destructive action of trophoblast cells. There is a tendency at present to disregard simple stretching of the tube by the growing ovum as a cause, or, at any rate, as a common cause of rupture. The great advance that has been made in our knowledge of the whole subject is the proof that has been obtained that tubal abortion is nothing else than a form of rupture, albeit internal rupture of the gestation sac. For this cause tubal rupture is now considered more in detail.

Among the various results which may follow the implantation of the impregnated ovum in the Fallopian tube is the process known as *tubal abortion*; as a matter of fact, it is now known that external rupture of the gravid tube is less frequent than was formerly thought, whilst the shedding of the gestation sac, in whole or in part, from the tube into the peritoneal cavity is much commoner than was supposed. Munro Kerr (*Operative Midwifery*, p. 538, 1908), indeed, regards tubal abortion as a more common occurrence than tubal rupture in cases of ampullar ectopic pregnancy; it is certainly much more often reported than it was at the time when the article on ECTOPIC GESTATION was written for the *Encyclopædia Medica* (Vol. III. pp. 183, 184, 1900). Tubal abortion may be complete, the whole ovum passing from the tube; hæmorrhage into the peritoneum is then inconsiderable, and probably ceases at once: this is comparable to the complete variety of ordinary abortion. There may, however, be an imperfect expulsion of the ovum from the tube, when what has been called the "ostial trickle" or drip-drop of blood from the infundibulum will continue and cause the formation of a hæmatocele. Complete tubal abortion may yield the explanation of some anomalous cases of the abdominal variety of ectopic pregnancy. In the case reported by Seeligmann (*Deutsche med. Wochens.*, xxxii. p. 879, 1906), for instance, gestation went to the full term, and the placenta was situated on the undersurface of the liver and gall-bladder, while a macerated foetus, weighing 10 lbs., was found lying in a sac in the abdominal cavity; and the author believed that the ovum at the end of the third month had escaped, with very little bleeding, through the open end of the tube, had not lost its vitality, and had been carried by the peristaltic movements of the bowels to the undersurface of the liver, where it had become attached, and had secured a vascular supply sufficient to enable the foetus to attain the weight of 10 lbs. If this be so, tubal abortion is not an unimportant occurrence. It is possible that Felix Meyer's case of primary (?) abdominal pregnancy (*Intercolon. Med. Journ. Australas.*, x. p. 145, 1905) may be explained in the same way as Seeligmann's.

At any rate, there can be no doubt about the reality of tubal abortion, for the gravid tube has been, so to say, caught in the act by several operators. Alban Doran, for instance, operated upon a patient regarded as suffering probably from right-sided tubal pregnancy; he found the right tube greatly distended, there was a mass of clot projecting from the ostium, and the peritoneal cavity contained not a drop of blood. The tube contained clot, and in the clot was an amniotic sac without an embryo; under the microscope numerous chorionic villi were found in the coagulum surrounding the sac (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 621, 1906). But a still more clearly demonstrated case was that reported by M. v. Strauch of Moscow (*Zentralb. f. Gynäk.*, xxiii. p. 1294, 1899), and Phillips (*Journ. Obstet. and Gynæc.*



*Brit. Emp.*, ix. p. 443, 1906) found a tubal mole in process of abortion during the operation of hystero-salpingotomy for ectopic pregnancy and peritonitis. In a patient whom Galabin (*Trans. Obstet. Soc. Lond.*, xlvii. p. 332, 1906) was examining bimanually under anæsthesia, a mass on the right side suddenly diminished in size, and on abdominal section some days later a fleshy mole was found in the pouch of Douglas; Galabin was of opinion that tubal abortion had occurred in consequence of the bimanual examination. In Karpow's patient (*Monatssch. f. Geburtsh. u. Gynäk.*, xviii. p. 778, 1903) the passage of the gestation sac from the tube into the abdomen seems to have been caused by a fall; at the time of operation a five months' foetus was found in the epigastric region, and the placenta was in process of extrusion from the ostium tubæ.

But there is not, as a rule, any history of traumatism to account for the occurrence of tubal abortion, and the question of its pathogenesis must then find another explanation. Werth (*Zentralb. f. Gynäk.*, xxvii. p. 851, 1903) has made the whole matter more easy of comprehension by calling tubal abortion "rupture of the internal capsule" in contrast with rupture of the tube into the peritoneum or broad ligament ("rupture of the external capsule"); and Berkeley and Bonney (*Journ. Obstet. and Gynec. Brit. Emp.*, vii. p. 93, 1905) speak of three varieties of rupture of the primary gestation sac—intra-tubal, or rupture into the lumen of the tube or tubal abortion, extra-tubal, which may be intra-peritoneal or extra-peritoneal, and intra-mural, when the sac ruptures into the substance of the tube wall. Rupture of the tubal pregnancy when it occurs into the lumen of the tube may be regarded as due to the destructive action of the trophoblast whose villi penetrate the internal capsule (Schambacher, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlvi. p. 428, 1903; von Franqué u. Garkisch, *Zeitsch. f. Heilk.*, xxvi. p. 274, 1905), or to hæmorrhage into the intervillous spaces, due to destruction of the vessel walls by the trophoblast or to blocking of the veins with deported villi (Veit, *Zentralb. f. Gynäk.*, xxvii. p. 849, 1903), or to contractions of the tube. The last-named theory would seem to derive some support from the specimen shown by M. von Strauch (*loc. cit.*, *supra*), in which the tube showed a deep depression on the outside corresponding to the attachment of the placental pedicle on the inside; and the occasional occurrence of intussusception of the tube (Mainzer, *Zentralb. f. Gynäk.*, xxvii. p. 921, 1903; Kermauner, *Beiträge zur Anatomie der Tubenschwangerschaft*, 1904) shows that the tubal muscle is active. The exact mechanism of tubal abortion, however, can hardly be regarded as satisfactorily settled.

When complete tubal abortion takes place it is probable that in most cases the tube returns to its normal state and the hæmatocele disappears gradually. The occurrence of incomplete abortion, however, causes a continuance of the signs and symptoms of ectopic pregnancy, and the patient probably is sooner or later submitted to operation.

**BIBLIOGRAPHY.**—A considerable literature has accumulated bearing specifically on the subject of tubal abortion. Some of the works have been referred to above; a few others may be named here:—BAZY. *Presse méd.*, xiv. p. 693, 1906.—BOURSIER. *Journ. de méd. de Bordeaux*, xxxii. p. 389, 1902.—BOURSIER. *Semaine gynéc.*, vii. p. 345, 1902.—BOUVIER. *Journ. de méd. de Bordeaux*, xxxiv. p. 69, 1904.—CARTLEDGE. *Med. Age*, xx. p. 289, 1902.—COE. *Ann. Gynec. and Pediat.*, xix. p. 1, 1906.—DONHOFF. *Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 1247, 1903.—EDGAR. *Glasgow Med. Journ.*, lv. p. 291, 1901.—FAIRBAIRN. *Journ. Obstet. and*



*Gynæc. Brit. Emp.*, x. p. 609, 1906.—FLATAU. *Münch. med. Wochensch.*, l. p. 2279, 1903.—HART. *Trans. Edin. Obstet. Soc.*, xxix. p. 209, 1904 (a paper in which, among other matters, the author suggests that the infundibular form of tubal pregnancy may be mistaken for a tubal abortion taking place).—HOOPER. *Intercolon. Med. Journ. Australas.*, x. p. 69, 1905.—JOHNSTONE. *Brit. Med. Journ.*, ii. for 1905, p. 1522.—LISSAR. *Thèse*. (Paris), 1903.—MANDL. *Monatssch. f. Geburtsh. u. Gynäk.*, xi. p. 203, 1900.—ORTHMANN. *Zeitsch. f. Geburtsh. u. Gynäk.*, xlix. p. 549, 1903.—PICHEVIN. *Semaine gynéc.*, x. p. 337, 1905.—*Ibid.*, xii. p. 89, 1907.—RAYNER. *Bristol Med.-Chir. Journ.*, xx. p. 323, 1902.—SPINELLI. *Arch. ital. di ginec.*, iv. p. 207, 1901.—STORER. *Boston Med. and Surg. Journ.*, cl. p. 5, 1904.—WATKINS. *Amer. Journ. Obstet.*, lii. p. 896, 1905.—FALK. *Zentralb. f. Gynäk.*, xxxi. p. 1404, 1907.—FITZGERALD. *Lancet*, ii. for 1907, p. 1457.—NYNLASKY. *Brit. Med. Journ.*, ii. for 1907, p. 1570.—H. C. TAYLOR. *Amer. Journ. Obstet.*, lvii. p. 837, 1908.—BOLDT. *Amer. Journ. Obstet.*, lviii. p. 483, 1908.

The *etiology* of tubal pregnancy now calls for attention. Of the many theories which have from time to time been advanced to explain the occurrence of ectopic gestation, some, such as external or internal wandering of the fertilised ovum, may be dismissed as insufficient to explain the facts, whilst others, such as puerperal atrophy of the tubes (favoured by Dührssen) and the presence of kinks, must be regarded as very doubtful. Some years ago inflammatory changes in the tube were regarded as the most probable causal agency, and it must still be admitted that salpingitis and ectopic pregnancy coexist too often to be explained away (Kermauner, Werth, Gottschalk, and others); the increase in the connective tissue of the tube which follows the occurrence of inflammation in an indirect way supports this view. Nevertheless, the prevailing theory at the present time seems to be that of antenatal modifications of the tube or the persistence of foetal conditions. It is doubtful, perhaps, whether there is much probability in the view put forward by Freund in 1888 that spiral windings of the tube (the persistence of an infantile state) are of etiological importance; but the more recent theory of implantation of the ovum in a tubal diverticulum (antenatal or acquired) or in an accessory tubal ostium cannot be easily dismissed, and has warm supporters in Micholitsch, Fellner, and Füh. Indeed the occurrence of diverticular implantation cannot be denied, and the only difference of opinion which can arise is with regard to its being *the* cause or only *one* cause of ectopic gestation (Heinsius). There is a general consensus of opinion that the chief cause is delay in passage of the ovum through the tube; it may be caught in an accessory ostium or in a diverticulum; it may be obstructed by a polypus or a spiral folding of the tube; it may be hindered by inflammatory adhesions; or it may have grown to such a size as to prevent its easy transmission. Webster's theory of decidual reaction (1895) as the determining factor cannot be said to have been strengthened by the discovery of genuine cases of ovarian pregnancy. If only a tissue derived from the Mullerian ducts has the power of growing a decidua, then, unless it can be proved that Mullerian tissue may invade the ovaries, it becomes impossible to account for gestation occurring in these glands. Another argument against this atavistic theory of origin of tubal pregnancy is found in the absence of any animal which normally has tubal pregnancies. It may, however, be found that another theory, as yet little heard of, may be of some importance—the view, namely, that the condition of the ovum itself has some effect in determining the position of its implantation; the ovum, for instance, may be too large to get through the tube (Sippel); twin ova may impede each other's progress (Hitschmann and Lindenthal); the ovum may have



reached at an earlier date that stage of development in which it can attach itself by the destructive action of its trophoblast, or its progress may have been delayed till that stage was reached (Sippel, 1901); or, again, the ovum may be pathological, and, on that account, may adhere more readily to the tubal mucosa. In favour of the last-named theory is the observation that the ovaries which have supplied the ova of ectopic pregnancies have frequently been found to be themselves pathological (*e.g.* cystic). It cannot, however, be claimed for any one theory of etiology that it satisfactorily explains all cases or meets all difficulties. Whether, as has been maintained by Seeligmann (*Zentralb. f. Gynäk.*, xxxi. p. 985, 1907), ectopic gestation is becoming more frequent cannot be easily determined; certainly it is more often diagnosed. The following articles bearing chiefly on etiology may be named:—Fellner, *Berl. klin. therap. Wochensch.*, p. 76, 1904; *ibid.*, *Arch. f. Gynaek.*, lxxiv. p. 481, 1904-5; Füh, *Arch. f. Gynaek.*, lxiii. p. 97, 1901; lxxii. p. 398, 1904; Gottschalk, *Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 210, 1906; Hitschmann and Lindenthal, *Zentralb. f. Gynäk.*, xxvii. p. 263, 1903; Kermauner, *Beiträge zur Anatomie der Tubenschwangerschaft* (Berlin), 1904; Micholitsch, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlix., p. 42, 1903; Pfaff, *Journ. Amer. Med. Assoc.*, xli. p. 1138, 1903; Roncaglia, *Ann. di ostet.*, xxiv. p. 289, 1902; Runge, *Arch. f. Gynaek.*, lxx. p. 690, 1903; Sippel, *Monatssch. f. Geburtsh. u. Gynäk.*, v. p. 437, 1897; Sippel, *Zentralb. f. Gynäk.*, xxv. p. 289, 1901; Werth, *Zentralb. f. Gynäk.*, xxvii. p. 850, 1903.

Some *varieties* of tubal pregnancy which were at one time regarded as very rare and even unique are now known to be comparatively common. Some of these may be briefly referred to. (1) There is, first, the occurrence of pregnancy in both Fallopian tubes at the same time; cases illustrating this form of plural ectopic pregnancy, which may be called bilateral tubal gestation, have been reported by Kristinus (*Wien. klin. Wochensch.*, xv. p. 1250, 1902), Sandberg and Burford (*Journ. Surg. Gynec. and Obstet.*, xxvii. p. 482, 1905), and others; but, of course, it can never be quite certain that the two pregnancies were of the same age, and as a matter of fact, in several of the recorded cases they have definitely been shown to be of different ages (see Jayle and Nandrot, *Rev. de gynéc. et de chir. abd.*, viii. p. 195, 1904). It is very probable that these cases are generally instances of repeated tubal pregnancy; thus in Haig Ferguson's observation (*Trans. Edin. Obstet. Soc.*, xxiv. p. 37, 1899), the right tube contained a lithopædion, while the left one showed a recent pregnancy of about three months. (2) *Repeated tubal pregnancy* must, therefore, be reckoned as a second rare variety of ectopic gestation, as, indeed, a more frequent occurrence than simultaneous bilateral tubal pregnancy. Ferguson (*loc. cit.*) collected from literature between fifty and sixty such cases; in most of them the second tubal pregnancy occurred on the opposite side, but this was not constant, for Taylor (*Brit. Gynaec. Journ.*, xiv. p. 94, 1898) had noted an instance in which the same tube was the site of the second implantation. Saniter's observation is difficult of interpretation; if it were repeated pregnancy in the same tube, then the relative size of the two embryos would indicate a difference in age of only one month; but it may have been a twin gestation with a difference in the rate of development of the two ova (*Zeitsch. f. Geburtsh. u. Gynäk.*, lv. p. 492, 1905). Since 1898 the number of records of repeated tubal pregnancy has been greatly increased, and in not a few instances the patient has been twice operated upon, twice by abdominal section (*e.g.* Dawson's case, *Journ. Obstet. and Gynaec. Brit.*



*Emp.*, iii. p. 301, 1903; Purslow, *Trans. Obstet. Soc. Lond.*, xlvii. p. 181, 1906). In Kokmann's case (*Zentralb. f. Gynäk.*, xxi. p. 1221, 1897) a normal pregnancy and labour intervened between the two tubal gestations. Two ruptured tubal pregnancies in the same patient within a year have been reported by M'Donnell (*Australas. Med. Gaz.*, xxvi. p. 287, 1907). (3) A third variety, which must still be reckoned as of great rarity, is the association of an ovarian pregnancy of one side with a tubal gestation of the other; in Psaltoff's case (*Ann. de gynéc. et d'obstét.*, lix. p. 376, 1903) the ovarian on the left side had an age of five years, while the tubal on the right side did not count more than five months. (4) Another variety is the presence of twins in a tubal gestation sac; and the foetuses may be of the same or of different ages. Cases have been reported by Child (*Amer. Journ. Obstet.*, lv. p. 94, 1907), Costa (*Ann. di ostet.*, i. for 1907, p. 185), Ferroni (*Zentralb. f. Gynäk.*, xxvii. p. 275, 1903), Heinricius and Kolster (*Arch. f. Gynaek.*, lviii. p. 95, 1899), Le Dentu (*Bull. acad. de méd.*, 3 s. xxxv. p. 214, 1896), and Rutherford (*Lancet*, i. for 1907, p. 881). Under this heading may be placed the still more extraordinary occurrence of a double monster being found in a pregnant tube (Kirchhoff, *Zentralb. f. Gynäk.*, xviii. p. 232, 1894). (5) What must surely be the rarest of complications is a triple ectopic gestation, and yet a case has been reported by Krusen (*Proc. Phila. Co. Med. Soc.*, N. S., iii. p. 292, 1901-2); and Michin has described an instance in which a simple pregnancy occurred in one tube and was followed two years later by a twin pregnancy in the same tube (*Monatssch. f. Geburtsh. u. Gynäk.*, xxii. p. 455, 1905). (6) A sixth variety is the simultaneous occurrence of intra-uterine (normal) pregnancy and extra-uterine (tubal) pregnancy. This cannot now be regarded as of great rarity, for Neugebauer has collected together 171 cases, including two seen by himself (*Zur Lehre von der Zwillingschwangerschaft mit heterotopem Sitz der Früchte* (Leipzig), 1907). Further, the sub-varieties have been shown to be more numerous than was once supposed. For instance, the extra-uterine pregnancy which is discovered during or after the course of the normal intra-uterine one may be of some years' standing; it may be what has been called a *sequestered* ectopic gestation, or one in which the foetus has died and been converted into a lithopædion or adipocere; and the extra-uterine sac may be a cause of delay and danger during the birth of the intra-uterine foetus. Another sub-variety is that in which the ectopic gestation is early converted into a tubal mole, or bursts into the peritoneum, or is discharged as a tubal abortion into the abdominal cavity; under these circumstances the intra-uterine pregnancy may go on uninterruptedly or may end as an abortion, the extra-uterine pregnancy may be operated upon and the intra-uterine one may either abort or go on to full term, or both pregnancies may come to an early end with dangerous accompaniments. A third sub-variety is that in which both the extra-uterine and the intra-uterine gestation go on to the full term with living foetuses. Although this combination constitutes a formidable difficulty and a most dangerous type of case, the skill of the operator has occasionally saved one or other of the children or the mother; while, in at least one case, the mother and both children survived (*Ludwig*). (7) A seventh variety to which reference must be made is pregnancy in the stump of an excised Fallopian tube. This may well appear to be almost an impossibility, nevertheless some well authenticated cases of stump-pregnancy have been put on record. Morfit (*Med. News*,



lxxvi. p. 869, 1900) removed the right tube and ovary for pyosalpinx in a young woman, and two years later he had to open the abdomen again, finding that there had been a pregnancy in the stump of the right tube which had ruptured. Vineberg (*Amer. Journ. Obstet.*, lvii. p. 527, 1908) had to deal with a patient complaining of the discharge of blood from the bowel. She had previously had the left tube and ovary removed by another operator, and now Vineberg found an irregular semi-elastic mass to the left of the uterus. On opening the abdomen he found the mass to be an ectopic gestation sac adherent to the sigmoid flexure, and he performed pan-hysterectomy; the right ovary contained a corpus luteum, so there must have been migration of the ovum. Another case of stump-pregnancy was reported by Hinder (*Australas. Med. Gaz.*, xxi. p. 414, 1902).

With the increase which has taken place in our knowledge of the pathology of ectopic gestation has come the possibility of more correctly deciding what the *complications* of the morbid state may be. A pelvic hæmatocele, for instance, must now be generally regarded as a result of an ectopic gestation rather than a complication; it is probably due, in most cases, to a tubal abortion. On the other hand, it is known that torsion of the tube may occur as a complication of tubal pregnancy (Pestalozza, *Boll. di Soc. Tosc. di Ostet. e ginec.*, i. p. 117, 1902; Schauta, *Zentralb. f. Gynäk.*, xxx. p. 160, 1906; Santi, *Ginecologia*, iii. p. 333, 1907; and Weckerling, *Diss. inaug. Giessen.*, 1907); it may be accompanied by uterine fibroids (Holmes, *Amer. Journ. Surg. and Gynec.*, xvi. p. 113, 1902-3), by ovarian cysts (Arnold, *Lancet*, i. for 1907, p. 1490), by pyosalpinx (Hitschmann, *Zeitsch. f. Geburtsh. u. Gynäk.*, liii. p. 1, 1904), or by cancer of the cervix (Rech, *Zentralb. f. Gynäk.*, xx. p. 421, 1896). It may also be followed by the development of a chorion-epithelioma (Hinz, *Zeitsch. f. Geburtsh. u. Gynäk.*, lii. p. 97, 1904).

#### PRIMARY ABDOMINAL PREGNANCY.

Whilst it may be said that the evidence in favour of the possibility of the occurrence of primary ovarian pregnancy is conclusive (see p. 181), the same cannot be affirmed of the *primary abdominal* variety. As a matter of fact, the demonstration of the ovarian type has weakened rather than strengthened the claims of the abdominal form, for it is very difficult to exclude the possibility of an early ovarian pregnancy undergoing rupture and becoming secondarily abdominal. Such a case as that reported by Herrenschmidt and Rigollot-Simonnot (*Ann. de gynec. et d'obstét.*, 2 s. iii. p. 695, 1906) illustrates this possibility, for during the operation of abdominal section a small lacerated spot was seen on one ovary from which blood was issuing drop by drop; during the handling of the ovary a small body, about the size of a pea, shot out of the opening in the ovary and was lost; the sac wall showed chorionic villi with syncytium and decidual elements. It is not difficult to imagine the same ejection taking place during a bimanual examination with subsequent attachment of the ovum to the peritoneum. It is doubtful, therefore, whether it will ever be possible to exclude entirely the possibility of an early ovarian pregnancy with rupture, or of an early tubal abortion in cases of alleged primary abdominal pregnancy. At the same time, a number of cases, with a high degree of probability attaching to them, have been recorded during the past few years.

Leaving out of account some cases reported near the close of the



nineteenth century (such as those of Ashton, *Ann. Gynec. and Paediat.*, v. p. 667, 1891-2; Doran, *Trans. Obstet. Soc. Lond.*, xxxv. p. 222, 1894; and Porro, *Ann. di ostet.*, xviii. p. 577, 1896), there have been some ten or a dozen specimens examined in the beginning of the present century which have strong claims to be regarded as primarily abdominal. The first case of the century claiming to be of this nature was that reported by V. Atlas of Astrachan, in Russia (*Ejened. Journ. Prakt. Med.* (St. Petersburg), viii. p. 22, 1901; abstract in *Zentralb. f. Gynäk.*, xxv. p. 1019, 1901); pregnancy went to the full term and was then operated upon. The gestation sac was in the abdominal cavity, and the placenta was attached to the left horn of the uterus and to the left broad ligament. The evidence in Witthauer's case (*Zentralb. f. Gynäk.*, xxvii. p. 136, 1903) was stronger than in Atlas's: the diagnosis of a tubal abortion was made, there having been amenorrhœa for two months, followed by abdominal pain, uterine hæmorrhage, and the development of a rounded tumour in the pouch of Douglas on the right side. The patient passed into a state of collapse, and the abdomen was opened; one and a half litres of blood were removed, and the healthy Fallopian tube of the right side along with the cystic ovary was taken away; a hæmatoma was discovered in the lower part of the omentum, which was ligatured and removed; when it was examined it was found to consist of an ovum surrounded by old and recent blood clot, and having the omentum rolled round it; there were chorionic villi, but they nowhere came into direct contact with omental tissue, being separated by the clot. The omentum had not contracted any adhesions with the tube, and, as has been stated, the ovary was cystic. Witthauer's opinion was that an ovum from the left ovary had become impregnated and had wandered across to the right side and been caught in a fold of the omentum; but he says nothing about the state of the *left* tube, and does not, therefore, exclude the possibility of a tubal abortion on that side of the body. In Galabin's case, also, the possibility of re-implantation after a hypothetical tubal abortion could not be excluded (*Brit. Med. Journ.*, i. for 1903, p. 664). Linck (*Monatssch. f. Geburtsh. u. Gynäk.*, xx. p. 1257, 1904) regarded his specimen as one of primary abdominal pregnancy, and Mayer's case (*Intercolon. Med. Journ. Australas.*, x. p. 145, 1905) had strong claims for inclusion in the list of very probable instances. In the latter, Mayer found in the abdomen a deformed foetus, seven inches in length, attached by the cranium to the omentum, but with no other adhesions; the Fallopian tubes were normal, and the ovaries were cystic; the placenta was attached to the upper part of the uterus and of the broad ligaments, and was also fixed to the omentum. Valdagni's case (*Ginecologia* (Florence), ii. p. 164, 1905) was an interesting one: after four months, during which her menstruation was scanty, the patient had a sudden attack of pelvic pain, followed in a few days by a flow of milk from the breasts. A year later a movable ovoid tumour was detected in the right iliac region; the performance of laparotomy revealed that the uterus, ovaries, and tubes were normal, and that the tumour, which was densely adherent to the bowel and omentum, contained a macerated foetus. Luigi Guidi's case (*Clin. ostet.* (Roma), viii. p. 147, 1906), another Italian observation, was somewhat similar; but the right tube was adherent to the omentum, in which the gestation sac, the size of a walnut and corresponding to four weeks in development, was folded up. Lovrich's observation (*Gynækologia* (Budapest), p. 70, 1907; *Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 704, 1908) was peculiar in the fact that the preg-



nancy went to the full time, when a spurious labour occurred, followed by the flow of milk from the breasts; six months later abdominal section was performed, and a gestation sac, connected with the left broad ligament by a broad pedicle and containing a mummified foetus, was removed; both tubes and ovaries were free from any connection with the sac, and the placenta was attached to the left mesosalpinx and extended upwards to the level of the umbilicus. The wall of the sac contained chorionic villi and a glandular tubal structure, whose presence Lovrich was puzzled to explain; he thought it might be a parovarian tubule, or, more probably, an accessory Fallopian tube upon which the ovum had fallen and in whose substance it may have developed. In a case operated on by von Ott and reported by Jarzeff (*Monatssch. f. Geburtsh. u. Gynäk.*, xxviii. p. 144, 1908), dermoid cysts of both ovaries were removed by vaginal section, and with them came away a number of clots and a small foetus which had been lying in the pouch of Douglas; the left Fallopian tube contained no products of gestation, and the right one appeared healthy and was not removed. Of course the anatomical diagnosis of this case could not be fully established, for the vaginal and not the abdominal operation had been performed. To complete this survey of alleged cases of primary abdominal gestations reference must be made to Otto Gröné's observation (*Zentralb. f. Gynäk.*, xxxiii. p. 45, 1909). It was made in the Malmö Hospital; the case was diagnosed as one of tubal gestation, and the abdomen was opened by Prag. Free blood was found in the pelvis, but neither the tubes nor ovaries showed any indications of pregnancy or of rupture. A bleeding surface the size of a mark piece was noted on the peritoneum anteriorly between the right round ligament and the cæcum; this was excised and the peritoneal edges brought together with sutures. This area represented, according to Gröné, the site of implantation of the ovum, and the microscopic appearances supported this view. Two bodies, one as large as a walnut, were found lying in the pouch of Douglas; one of them was solid and the other porous, and they both showed the cellular constituents of the villi (syncytium and Langhans's cells). No trace of an embryo was discovered.

If, now, we sum up the evidence in favour of primary abdominal pregnancy, it is obvious that it cannot be regarded as a clearly demonstrated possibility of ectopic gestation. It seems to be almost impossible to exclude the occurrence of tubal or ovarian rupture or of tubal abortion at a very early stage, with secondary implantation of the ovum, on the peritoneum and the *restitutio ad integrum* of the original site of grafting. The evidence from the occurrence of similar conditions in the lower animals, *e.g.* Leiserung's case in a cat, and Bruno Wolff's in a bitch, is not conclusive. Primary abdominal gestation must still be regarded as a probable, but as yet unproved, occurrence in the course of extra-uterine pregnancy. The secondary abdominal variety is, of course, well known, and the possibility of the implantation of the placenta, in whole or in part, on the peritoneum has been clearly established.

#### SECONDARY ABDOMINAL PREGNANCY.

Perhaps the most important addition that has been made to our knowledge of the secondary variety of abdominal gestation has been the increased experience which operators have gained in the management thereof. In the early months, before the placenta has become the



important organ into which it develops later, the operative interference necessary does not differ in any marked fashion from that required in early tubal or ovarian pregnancy. The embryo may be found, with or without its amnion, rolled up in a fold of the omentum, while a portion of the foetal sac with the developing placenta remains in the ruptured tube; under these circumstances, the part of the omentum containing the embryo may be ligatured and removed, while the tube is taken away in the usual manner. Again, the foetal sac may not yet have acquired any firm connections with the omentum, but be only slightly adherent to the intestines, then it will usually be easy to separate it and remove it along with the tube from which it has emerged. The difficult cases are those in which the pregnancy is prolonged to the full term and beyond it; in which the placenta has time to acquire strong vascular connections with the peritoneum, intestines, or even with the liver; and in which the foetal sac, being intra-peritoneal, and being composed sometimes of nothing save the delicate amniotic membrane, does not lend itself readily to marsupialisation. Then, indeed, the operator requires all his skill and judgment to deal successfully with the emergency which is almost certain to arise at or soon after term is reached, unless, indeed, the foetus dies, remains uninvaded by microbes, and becomes converted into a lithopædion. In the last-named circumstances the state of affairs may only be discovered at a post-mortem examination made many years later, the patient dying from some other disease (*e.g.* pneumonia or heart disease). In Wallart's case (*Zeitsch. f. Geburtsh. u. Gynäk.*, lix. p. 222, 1907), for instance, the patient died at the age of eighty-five, while in Haultain's (*Journ. Obstet. and Gynæc. Brit. Emp.*, vi. p. 308, 1904) the lithopædion must have lain for forty-one years in the abdomen. But the formation of a lithopædion with subsidence of active symptoms and the disappearance of danger cannot be counted upon, and preparations ought to be made for the operative treatment of full-term abdominal pregnancies. Diagnosis is not the difficulty. J. W. Taylor (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 511, 1906) says: "In many cases the child may be almost seen through the loose abdominal walls, and, as the liquor amnii is usually deficient, the foetus can be palpated with extraordinary precision and facility." Of course it is possible that the pregnancy may be tubo-ligamentary (*i.e.* the child may have developed between the layers of the broad ligament and consequently outside or behind the peritoneum) or even tubal, but the probabilities are, that if an extra-uterine gestation reaches full term and has the characters described by Taylor it is a secondary abdominal one. What then is to be the treatment?

In the first place, it may be well to recognise the difficulties and dangers to be met with when the abdomen has been opened, and Potocki's case will serve as a useful warning (*Ann. de gynéc. et d'obstét.*, 2 s., v. p. 92, 1908). The patient, twenty-three years of age, was pregnant for the first time, and was nearly at the ninth month. At the end of the fourth month she had suffered from intense abdominal pain, lasting for three days; it was thought that she was aborting or was suffering from peritonitis, but no hæmorrhage occurred, and she gradually recovered. About a month later the pain returned, with vomiting and syncope, and after this the patient remained at rest in bed until the full term. The abdomen was markedly irregular in its enlargement; palpation discovered the foetal parts, which were very easily felt, the head lying in the left flank, while a structure, believed to be the uterus, was on the



right side. The foetal heart was heard in the middle line, above the level of the umbilicus. Full-time extra-uterine pregnancy with a living infant was diagnosed. It was determined to open the abdomen at once. The amnion was found to be slightly adherent to the anterior abdominal wall. When the adhesions were separated the placenta could be seen in the lower part of the amniotic sac with the foetus lying above it; to the right side was the uterus, congested, and somewhat enlarged. An opening into the gestation sac was made as far as possible from the placenta, and the foetus was quickly extracted; it was alive, and soon began to cry. The placenta now seemed to be separating of itself, but Potocki, on attempting to trace its connections, was met with a terrific hæmorrhage, which did not cease till he had clamped the uterine and ovarian vessels. Since the wall of the sac consisted of the amnion alone, it could not be marsupialised, and so the whole mass, with the placenta, was separated from its surroundings and removed. The uterus and the left tube and ovary were left behind, and the abdominal incision was closed. The patient made a good recovery, and the child, at the age of two and a half years, is alive, but is unfortunately a microcephalic idiot. The placenta, it was found, had been inserted upon the isthmus of the tube.

Keeping Potocki's case in mind, we are better able to recognise the special dangers and difficulties of operating upon full-time abdominal pregnancies. The wall of the sac is so thin and friable that marsupialisation, that convenient resource in some other forms of ectopic gestation, is rendered impossible of performance; the living placenta has vascular attachments which are so extensive as to produce tremendous hæmorrhage if separated at once; and it is not always possible to leave the placenta *in situ*, for, as was seen in Potocki's case, it may begin to come away of itself. It may therefore be thought better to wait till the full term is past and the foetus dead; but, on the other hand, there is the chance of saving the infant, if the operation be performed at term, and, as Potocki's case shows, the child may not only be born alive but may survive. It is true that the full-time infant of an extra-uterine pregnancy has a smaller chance of being well formed than has one from a normal pregnancy; still, a sufficient number of cases of survival of such infants has now been recorded to prove that their lives are far from negligible (see von Winckel's work *Über die Missbildungen von ektopisch entwickelten Früchten und deren Ursachen* (Wiesbaden), 1902), and that they may enjoy good health and be mentally well developed. It will probably be found to be the better plan for the sake of child as well as mother to operate at term. The operation should be carefully prepared for, and special attention should be paid to asepsis; no special difficulties are likely to be met with until the operator comes to deal with the placenta and has to decide whether to take it away or to leave it to come away for itself. The risk of almost uncontrollable hæmorrhage accompanies the former procedure, while the latter is attended by the risk of sepsis. J. W. Taylor (*loc. cit.*) has suggested a third plan of treatment. He says that two forms of placenta are met with: one may be called the "ball-like," and is covered nearly everywhere by amniotic reflexion; the other may be named "discoid," and has only one surface free from vascular attachments; the former can generally be removed with safety, the latter cannot. Although some vascular twigs from omentum or intestine may contribute to the supply of the placenta, its chief vessels are always



those of the broad ligament (ovarian and uterine), and the plan of treatment, therefore, must consist in finding and securing these before the removal of the placenta is attempted. This, Taylor says, is easy with the "ball-like" placenta, but very difficult with the "discoid." He suggests, therefore, that in the latter emergency the child and cord should be removed, the amniotic sac carefully washed out, and the cavity containing the placenta closed in, and that structure left to be absorbed. Of course the success or failure of this plan will depend entirely on the degree of perfection of the aseptic precautions which can be attained.

A large number of articles discussing secondary abdominal pregnancy have appeared during the past five or six years; only a few of the more important or more easily accessible are named here:—Barozzi, *Gynécologie*, xi. p. 489, 1906; Beale, *Med. Press and Circ.*, N. S., lxxxii. p. 360, 1906; Brothers, *Amer. Journ. Obstet.*, lvii. p. 109, 1908 (a case in which the pregnancy was further complicated by the presence of a fibroid tumour); Garkisch, *Prag. med. Wochensch.*, xxxiii. p. 149, 1908; Hellier, *Journ. Obstet. and Gynec. Brit. Emp.*, v. p. 438, 1904; Marsh, *ibid.*, ix. p. 438, 1906; Pestalozza, *Ginecologia*, i. p. 42, 1904; Potocki and Bender, *Ann. de gynéc. et d'obstét.*, 2 s., i. p. 581, 1904; Prüsmann, *Zeitsch. f. Geburtsh. u. Gynäk.*, lii. p. 288, 1904; Reed, *Trans. Amer. Assoc. Obstet. and Gynec.*, xviii. p. 239, 1906; Sittner, *Deutsche med. Wochensch.*, xxxii. p. 1200, 1906 (the infant was alive in this case); Weiss, *Zentralb. f. Gynäk.*, xxxii. p. 251, 1908 (both mother and child lived). Articles dealing more particularly with the treatment of these difficult cases are those of Freund (*Samml. klin. Vortr.*, No. 448, 1907), Hellier (*Trans. Obstet. Soc. Lond.*, xlv. p. 366, 1904), Jacomet (*Echo méd. du Nord.*, xi. p. 292, 1907), Tate (*Journ. Obstet. and Gynec. Brit. Emp.*, x. p. 592, 1906), and Vallois (*Bull. soc. d'obstet. de Paris*, vii. p. 315, 1904).

#### OVARIAN PREGNANCY.

*Ovarian Pregnancy.*—When the *Encyclopædia Medica* was published (in the last year of the nineteenth century) it was permissible to write of ovarian pregnancy as "a possibility denied by many," and to state that "for all practical purposes the tubal variety was the only primary form" of ectopic gestation; but there can be now no longer any doubt about its possibility, and alongside of the tubal form of extra-uterine pregnancy we must at the present day place primary ovarian pregnancy, and perhaps also primary abdominal gestation.

*Historical Note.*—Although ovarian pregnancy had been suspected by previous writers, to Dr. Catharine van Tussenbroek of Amsterdam belongs the credit of giving the first complete demonstration of its actual occurrence. Her communication took the form of a report on a specimen removed by Dr. Kouwer from a patient, thirty-one years of age, who had had six weeks' amenorrhœa, and who was believed to be suffering from extra-uterine pregnancy. The right ovary was found, at the operation, to be surrounded with clots, and the abdomen was full of blood. There was no attachment of the tube to the ovary. In the latter was an ovisac, containing a small half-macerated embryo, lying within a corpus luteum. The ovum was surrounded by villi, and these were covered both with syncytium and with Langhans's cellular layer. Dr. van Tussenbroek's paper was published in the *Nederl. Tijdschr. v. Verlosk. en Gynæc.* (Haarlem) (vol. x. pp. 187-214, 1899), and in the



French *Annales de Gynécologie* (vol. lii. pp. 537-573, 1899); a translation also appeared in the *St. Louis Courier of Medicine* (vol. xxiii. p. 1, 1900). The publication of this report excited much interest, and attention was again drawn to the subject of primary ovarian pregnancy; some gynecologists remained sceptical, but those who were able to examine the specimen itself were convinced, and the matter was finally decided soon afterwards by the publication of a number of other cases, some of which at least were clearly shown to be of the nature of gestation in the ovary. Reference may here be made to the reports of H. Gilford (*Brit. Med. Journ.*, ii. for 1901, p. 963), of E. O. Croft (*Trans. Obstet. Soc. Lond.*, xlii. p. 316, 1900), of Anning and Littlewood (*Trans. Obstet. Soc. Lond.*, xliii. p. 14, 1902), and of Mayo Robson (*Journ. Obstet. and Gynec. Brit. Emp.*, ii. p. 11, 1902). The first part of the first volume of *American Gynecology* (1902) opened with an article on ovarian pregnancy by J. F. Thompson, with the report of a case in which an exploratory abdominal incision was made to determine the nature of an extremely tender swelling in the left side of the pelvis; a small tumour of the left ovary was found, with the Fallopian tube projecting clear of its outer end; a tumour about the size of a horse-chestnut was attached to the upper end of the enlarged ovary, and in it was an ovisac containing an embryo of a size corresponding to twenty-five or thirty days. In the same year Mendes de Léon and Holleman (*Rev. de gynéc. et de chir. abd.*, vi. p. 387, 1902) reported a case of ectopic gestation which was possibly ovarian, and in the next year Micholitsch (*Zeitsch. f. Geburtsh. u. Gynäk.*, xlix. p. 508, 1903) met with two cases of ovarian pregnancy in a series of 120 operations for extra-uterine gestation. When, in 1904, Ludwig Kantorowicz (*Samml. klin. Vortr.*, No. 370, 1904) related two new cases of ovarian pregnancy, he was able to state that, altogether, nineteen undoubted instances had been put on record, with ten probable ones and fourteen doubtful. But Kantorowicz's list was incomplete, and, since 1904, a number of additional cases have been observed, including the British ones of J. K. Kelly and Louise M'Ilroy (*Journ. Obstet. and Gynec. Brit. Emp.*, ix. p. 389, 1906), of Hewetson and Lloyd (*Brit. Med. Journ.*, ii. for 1906, p. 568), of Law (a doubtful instance, *Brit. Med. Journ.*, ii. for 1906, p. 866), and of J. Munro Kerr (*Proc. Roy. Soc. Med.*, i., Obstet. Sect., p. 268, 1907-8), and the American ones of J. C. Webster (*Amer. Journ. Obstet.*, l. p. 28, 1904; *Trans. Amer. Gynec. Soc.*, xxxii. p. 122, 1907), who had previously been firmly persuaded of the impossibility of the occurrence of the ovarian variety of ectopic gestation; and of Norris and Mitchell (*Surg. Gynec. and Obstet.*, vi. p. 460, 1908). Weibel's case (*Arch. f. Gynaek.*, lxxxvi. p. 210, 1908) differed from most of the previously reported observations, in that the foetus had been converted into a lithopædion.

*Pathology.*—The anatomical and histological evidence necessary for the proof of an ovarian pregnancy consists in the absence of the ovary of the corresponding side of the body, the presence of ovarian tissue in the wall of the gestation sac, the attachment of that sac to the uterus by the ovarian ligament, the complete freedom of the Fallopian tube of the same side and of the opposite side from any participation in the formation of the sac, and the existence of the same topographical relations of the sac as are met with in an ovarian cyst. In the presence of these conditions, which more than fulfil the requirements of Lawson Tait, the diagnosis of a primary ovarian gestation is established. The pathological details of the recorded cases have shown considerable



differences. In the van Tussenbroek specimen the gestation sac was within a corpus luteum and had a theca interna consisting of large cells resembling those of the decidua; inside the theca interna was a layer of connective tissue, and within that was the ovum covered with villi possessing both layers, syncytium and Langhans's cellular layer. In J. F. Thompson's case, also, the ovum seems to have been in a corpus luteum, but there were no decidual cells and no trace of an amnion; there was an embryo, 1.2 cm. in length, with an umbilical cord 1.5 cm. long attaching it to the chorion. The case of Anning and Littlewood was also one in which the ovum occupied the corpus luteum. The ovum, however, is not always so situated. In Hewetson and Lloyd's case, for instance, an intact corpus luteum bulged into the gestation sac, from which it was everywhere separated by a layer of ovarian stroma; in Webster's first case (1904) the cavity in which the ovum had developed may have been a Graafian follicle, but, if so, it was not a ripe one, and no formation of a corpus luteum had followed; in Busalla's case (*Arch. f. Gynaek.*, lxxxiii. p. 612, 1907) the original seat of implantation was probably a corpus luteum, but it had burst, and the ovum had implanted itself in the tunica albuginea on the surface of the ovary near the site of the rupture ("epovarial" implantation of Schickele); in the specimen described by Munro Kerr the ovum was embedded in ovarian tissue outside the Graafian follicle (corpus luteum); and in that of Kelly and M'Iroy the pregnancy had occurred in a Graafian follicle, but was found separated from it by a layer of connective tissue and fibrin. It is evident, therefore, that an ovarian gestation may have its seat in a Graafian follicle or in a corpus luteum, in ovarian tissue outside either, or on the surface of the ovary. In other details there are also differences. The gestation sac may have been converted into a mole (Micholitsch, *loc. cit.*; Gilford, *loc. cit.*), or it may show amnion and chorion and an embryo (Freund, *Deutsche med. Wochens.*, xxx. p. 1670, 1904), or a chorion containing an embryo (Freund and Thomé, *Virchow's Arch. f. Path. Anat.*, clxxxiii. p. 54, 1906). The villi of the chorion have been found showing both syncytium and Langhans's layer of cells. The presence of decidual cells or of lutein in the immediate neighbourhood of the gestation is far from constant. Webster (*loc. cit.*, 1904), Herrenschmidt and Rigollot-Simonnot (*Ann. de gynéc. et d'obstét.*, 2 s., iii. p. 695, 1906), and van Tussenbroek (*loc. cit.*) have described decidual cells or large cells closely resembling them; but Gottschalk (*Zeitsch. f. Geburtsh. u. Gynäk.*, xlviii. p. 360, 1903), Hewetson and Lloyd (*loc. cit.*), and Kelly and M'Iroy (*loc. cit.*) found no decidual elements, and Freund (*loc. cit.*) saw neither decidual cells nor a lutein layer. The absence of decidual cells in ovarian pregnancies has a bearing upon the pathogenesis of ectopic gestation in general; for it seems to show (contrary to Webster's contention) that pregnancy can occur without a preceding decidual or genetic reaction. Indeed, ovarian pregnancies apparently prove that the impregnated ovum can be implanted upon a tissue which is not Müllerian in origin, although it has been argued by Webster (*loc. cit.*, 1904) that there may be an occasional extension of Müllerian tissue into the ovary leading to the development (in pregnancy) of localised areas of decidua-like cells. Some of the recorded specimens seem, on the other hand, to support the view that the ectopic gestation can be best implanted on vascular connective tissue (Kelly and M'Iroy and Munro Kerr, *loc. cit.*)—a view which has been strongly advocated in the past but never fully established. It is very interesting to observe



how closely the ovary resembles the uterus in the response it makes to the presence of an impregnated ovum in it, although it differs so completely in its histological characters. *Clinically*, an ovarian pregnancy cannot be differentiated from the other forms of ectopic gestation. Early death of the embryo or the conversion of the gestation into a mole is probably the common result of pregnancy in this organ, and early rupture would seem to be the rule. Menge (*Münch. med. Wochensh.*, No. 49, p. 2452, 1907), however, has recorded a case in which a right-sided ovarian pregnancy went to the full term and was removed by abdominal section, the child in it being alive. Further, to make this remarkable case absolutely unique, a living child had been expelled from the uterus, without causing rupture of the extra-uterine sac, just before the performance of the abdominal section; the mother, Menge adds, was suckling both infants. In Munro Kerr's case, also, there was a coincident intra-uterine gestation; the right ovary, containing a gestation sac of about five weeks, was removed by abdominal section on 13th January 1903, and on 19th August of the same year the patient was delivered of a full-time healthy child (*Operative Midwifery*, p. 545, 1908).

Ovarian pregnancy, therefore, must now be regarded as one of the well proven varieties of ectopic gestation taking its place alongside of tubal and cornual pregnancy. As our knowledge of this variety grows with the multiplication of records and specimens, it is certain that its pathological possibilities will be more clearly appreciated, and it is possible that its clinical characters may be better defined.

#### DIAGNOSIS.

It cannot be claimed that during the past few years any very remarkable advances have been made in the diagnosis of ectopic pregnancy. Operative successes have indeed made us better acquainted with the varieties and complications of extra-uterine gestation, and the gynecologist is better able to deal with the conditions he may find when he has opened the abdomen; but, previous to operative interference, there must still be considerable doubt as to diagnosis. The recognition of the nature of the morbid state is not difficult when rupture of the tube into the peritoneum has occurred and is accompanied by great hæmorrhage causing profound collapse; we have, of course, to keep in mind the possibility of rupture of a gastric or duodenal ulcer, of a violent attack of appendicitis, and of torsion of the pedicle of an ovarian cyst or uterine fibroid. In such cases, the general surgeon will think first of intestinal states, and the gynecologist of tubal and uterine ones; but both will open the abdomen, and thereafter diagnosis is easy. More difficulty is met with in connection with early ectopic pregnancies in which the symptoms are slight and irregular, and in which such occurrences as tubal abortion, rupture between the layers of the broad ligament, or formation of a tubal mole are taking place. Irregularity in the symptomatology of the first months of pregnancy, leading in many cases to the abandonment of the diagnosis of ordinary pregnancy which had been made by the patient or her medical attendant, must be regarded as suggestive of the ectopic variety. The occurrence of irregular uterine hæmorrhage accompanied by abdominal pain (often of the colicky type) and sometimes with the discharge of a decidual membrane, along with feelings of sickness and sometimes of



syncope, should rouse our suspicions, but very often rather direct our thoughts to threatened or incomplete abortion. Indeed one of the commonest mistakes is to confound an ectopic pregnancy with an abortion and an abortion with an ectopic pregnancy. When, as in one of Munro Kerr's cases (*Operative Midwifery*, p. 560, 1908), there is appendicitis as well as abortion, such a mistake in diagnosis is not difficult to make. Other errors are the confusing of the ectopic pregnancy with retroversion of the gravid uterus, with pyosalpinx, with an ovarian or a uterine tumour, with malformations of the uterus, or with pregnancy in a rudimentary horn, etc. In all these cases the bimanual examination will give a chance of accurate diagnosis; but it must be very carefully and very gently carried out, as the chance of rupturing an ectopic gestation sac during such a manipulation is not imaginary. The use of the uterine sound may be helpful, but it is not free from risk; the curette also is dangerous, and the microscopic examination of the scraping, unless it show villi, does not serve to distinguish an intra-uterine from an extra-uterine pregnancy. The Röntgen rays have been used in diagnosis by Salin, Stein, and others, but with no very certain advantage or results. In many cases the gynecologist will still be in doubt as to his diagnosis when he opens the abdomen. When the ectopic gestation goes on to full term the diagnosis is not nearly so difficult; the previous history of the patient, the disturbance of the pelvic functions of micturition and defæcation, the presence of two tumours in the abdomen (uterine and extra-uterine), the ease with which foetal parts are felt, and sometimes the occurrence of a "spurious labour" all help the gynecologist to a correct estimate of the condition. The possibility of mistaking hydramnios in a thin-walled uterus for an extra-uterine pregnancy must, however, be borne in mind. Perhaps the most puzzling cases are those in which the foetus has died and the ectopic sac has shrunk and become "sequestered"; such remains of old extra-uterine pregnancies may be met with in the abdomen in women of any age up to seventy and even eighty. Of course, in making a diagnosis one has to keep the possibility of ectopic pregnancy existing alongside of a normal pregnancy or of some other morbid state, such as an ovarian tumour. Sittner's article (*Deutsche med. Wochensch.*, xxix. pp. 743, 759, 787, 1903) gives a good account of the difficulties of diagnosis in ectopic gestation, and other useful papers are by Sir Halliday Croom (*Practitioner*, lxxii. p. 601, 1903), Eustache (*Journ. d. sc. méd. de Lille*, ii. p. 97, 1903), Fabricius (*Wien. med. Presse*, xlviii. pp. 498, 542, 1907), Grandin (*Amer. Gynec.*, ii. p. 42, 1903), Haultain, (*Journ. Obstet. and Gynec. Brit. Emp.*, ix. p. 403, 1906), Lichtenstein (*Münch. med. Wochensch.*, liii. p. 498, 1906), Milligan (*Journ. Obstet. and Gynec. Brit. Emp.*, ix. p. 423, 1906), Pestalozza (*Ginecologia*, i. p. 545, 1904), Reynolds (*Boston Med. and Surg. Journ.*, cxlvi. p. 306, 1902), and by Vineberg (*Journ. Amer. Med. Assoc.*, xxxvi. p. 1305, 1901). There are certain very difficult matters, such as the distinction between an interstitial or tubo-uterine pregnancy and an angular pregnancy (*i.e.* implantation of the ovum in the upper angle of the uterus over the tubal ostium), which the diagnostician can hardly hope to settle prior to abdominal section.

#### TREATMENT.

During the past few years the experience of gynecologists has been such as to encourage, more and more, operative methods in dealing



with ectopic gestations of all kinds and at all stages. The *expectant plan* of treatment has been less and less used; for while it is quite likely that tubal moles and tubal abortions may in time be absorbed or rendered innocuous by prolonged rest, yet there are risks of no small magnitude during the process, and these operation is generally able to remove; at any rate, the convalescence will be much hastened after a properly carried out laparotomy or vaginal section. If, therefore, an ectopic gestation has been diagnosed, the rule is to operate, and expectant treatment is permissible only while the ectopic gestation remains intact and its diagnosis consequently uncertain.

With regard to the question of which is the *better route* to be followed in operating upon early extra-uterine pregnancy, it cannot be stated that the vaginal has yet been shown to be preferable to the abdominal. Strassmann (*Berl. klin. Wochensch.*, xxxix. pp. 563, 588, 613, 1902) and Orthmann (*Deutsche med. Wochensch.*, xxxiv. p. 192, 1908) are strongly in favour of the vaginal route; and the latter supports his argument with much statistical evidence, maintaining that vaginal section, especially anterior colpo-cœliotomy, gives a sufficiently good survey of the field of operation, allows rapid access to the diseased tube, avoids shock and the after-risk of hernia, and has a shorter convalescence. He admits that the vaginal operation is more difficult, and is only to be employed up to the end of the third month. Bröse (*Zeitsch. f. Geburtsh. u. Gynäk.*, xliii. p. 389, 1900), Child (*Yale Med. Journ.*, x. p. 101, 1903), De Paoli (*Rassegna d'ostet. e ginec.*, xvi. p. 273, 1907), Ford (*Trans. Amer. Gynec. Soc.*, xxxi. p. 157, 1906) and others have operated by the vaginal route; but whilst it is true that good results have been obtained, both by posterior and anterior colpotomy, and whilst it must be admitted that an operation begun by abdominal section may require to be terminated by vaginal drainage, still the practice of gynecologists seems to be to employ abdominal section more frequently than vaginal for gestations of all ages.

With regard, next, to details, several matters must be looked upon as still undecided, but we are rapidly approaching the time when a definite policy shall have been settled for all the varieties and possible emergencies of ectopic gestation. Let us consider first the fairly well decided methods to be employed in early pregnancies, and then the less defined plans for the later cases.

In the presence of an early rupture of the pregnant tube with signs of internal hæmorrhage there is, of course, no doubt that the abdomen should be opened, the sac removed and the hæmorrhage stopped. The only matter in dispute is whether this should be done during the continuance of the state of shock or after reaction has come on. While there is some advantage in waiting till the period of shock is past, it is not great, and the weight of opinion, at any rate among operators, is on the side of immediate operation, by the abdominal route, and under light anæsthesia. A saline may be infused during the section. There is no great change in the technique; but it is of service to clamp the broad ligament with pressure forceps outside and inside the ruptured tube before doing anything else. There is no need to remove the ovary unless it be diseased, but it is not yet clear whether any attempt should be made to conserve a *ruptured* tube.

In early ectopic pregnancies in which as yet there are no cataclysmic symptoms pointing to the inundation of the peritoneum with blood from a ruptured tube the indication is still to open the abdomen and



remove the gestation sac. The sac may be found in the wall of the tube, partly extruded through the ostium, free in the peritoneal cavity, or attached to the omentum; in any case, its blood-supply is to be secured and itself removed. In the case of tubal moles and even of ordinary growing tubal pregnancies the attempt has been made to conserve the tube by dilating it or by splitting its wall and removing the sac; of course if this be done great care will have to be taken to secure all bleeding points and suture the opening. As a general rule, however, the tube is to be taken away and the ovary left, and the details of the operation are usually quite simple. Where the gestation has become intra-ligamentary the difficulties may be more formidable, and it may be necessary to drain the sac with gauze brought out through the vagina. If the gestation be in the isthmus or in the uterine wall (interstitial) it will always be well to try to save the uterus (Wimmer, *Zentralb.f. Gynäk.*, xxvii. p. 52, 1903); but in some cases this will be found to be impossible, and then subtotal hysterectomy will be needed, as in Bertram Hunt's patient (*Brit. Med. Journ.*, ii. for 1906, p. 777).

The operative treatment of ectopic gestations in the latter half of pregnancy and at or after the full term is a matter about which there is not yet the same crystallisation of expert opinion as exists regarding the management of the earlier cases. Shall we delay operation till the full time in order to give the child a chance? Shall we wait beyond the full term for the death of the foetus in order to have to deal with a dead instead of a "quick" placenta? Shall we try to remove the placenta at the same time as the infant, or shall we allow it to remain till its vascularity has lessened and then take it away? These are three of the undecided problems in the management of ectopic gestation at or near full term. There seems, however, to be a general inclination to answer the first question in the negative, and I believe that ultimately the second one will receive a similar answer; the reply to the third must depend upon circumstances. If, on opening the abdomen, the operator finds that he can easily secure the blood-supply of the gestation sac, he ought to do so and then remove the sac entire with the foetus and placenta inside. Potocki (*Ann. de gynéc. et d'obstét.*, 2 s., v. p. 92, 1908), from experience gained in the treatment of some difficult cases, is of opinion that hæmostasis gained by clamping the uterine and ovarian arteries on the affected side should be the first step after the abdomen has been opened. As a general rule, however, the operator opens the sac and removes the foetus; if the foetus be macerated and the placenta in consequence be not "living," it may then be good treatment to strip off the latter and close the sac and the abdomen. It may, however, be wiser to stitch the margin of the sac to the abdominal incision (marsupialisation). If the foetus be alive (or only recently dead) and the placenta consequently "quick," the operator will have to decide whether he will take away the placenta or leave it; if he can secure the vessels of the broad ligament he may take the placenta away, and if it lie *above* the foetus in the sac he will require to take it away; but if not, he will probably be well advised not to try to separate it, as the bleeding from the site will certainly be very great, and may even be impossible to check. He may remove the foetus, cut off the umbilical cord close to the placenta, and marsupialise the sac, making an attempt to remove the after-birth in ten or twelve days; or he may entirely close the sac on the abdominal side and open



and maintain a communication with the vagina by means of a gauze drain, and hope to remove the placenta per vaginam. Both these methods, however, entail a long convalescence (Malcolm, *Journ. Obstet. and Gynæc. Brit. Emp.*, iv. p. 435, 1903). The worst cases are those in which the gestation sac is widely adherent to omentum, intestines, and even to the liver; then packing with gauze and marsupialisation of the sac is often the only possible treatment. It must also be borne in mind that the friable nature of the sac sometimes makes marsupialisation very difficult; this is specially true of the tubo-abdominal gestations in which the sac is made up of nothing more than amnion.

There are, therefore, several details in the technique of ectopic gestation operations which must in the meantime be left undecided, but the growing experience of gynecologists will gradually reduce speculation to order and give certain rules where at present there are only tentative recommendations. Of one thing the operator may be certain—that the most hopeless-looking cases are capable in the hands of a skilled gynecologist of successful management. Take, for instance, Döderlein's remarkable record: he operated for tubal gestation; in three days the incision gave way during an attack of coughing and intestine was prolapsed, and he had to reopen the wound and replace the bowel; then signs of strangulation appeared, and for a third time he opened into the abdominal cavity to separate adhesions; and yet the patient recovered (*Zentralb. f. Gynäk.*, xxix. p. 528, 1905).

There is a great literature on the subject of the treatment of ectopic pregnancy. For the ordinary reader the articles in Allbutt's *System of Gynæcology* (2nd ed., p. 635, 1906), and in Munro Kerr's *Operative Midwifery* (p. 566, 1908) will be found of great value; while the *Journal of Obstetrics and Gynæcology of the British Empire* has since 1902 furnished the specialist with carefully made summaries of important articles, British and foreign.

**Electricity (High Frequency Currents) in Skin Diseases.**—High frequency currents have been tried in the treatment of various skin eruptions. The current is applied from a glass or wire-brush electrode. It has no specific action, being merely stimulating to the tissues, and therefore is sometimes useful in obstinate cases of eczema, especially the form associated with lichenification. It has also been used in acne, lupus, and sycosis.

REFERENCE.—LEWIS JONES. *Medical Electricity*, 1904.

**Embryotomy or Embryulcia.**

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INDICATIONS.—Little requires to be added to the article in the *Encyclopædia Medica* (Vol. VIII. pp. 528-534) which deals with this subject, for the past five or six years have witnessed not an extension but a restriction of the sphere of application of destructive operations upon the unborn infant. The operation of embryulcia is more and more being restricted to those cases in which the infant is already dead in



utero or in which its life is almost negligible (on account of gross malformations or teratological states), and in which there is some serious obstacle to delivery, such as contraction of the pelvis (conjugate of two and a quarter to three and a quarter inches) and neoplasms of the soft or hard canals. The operations of Cæsarean section, of pubiotomy, and of the premature induction of labour have narrowed down the indications for embryulcia in a very marked manner. Especially is it the case that extra-peritoneal (supra-symphysary) Cæsarean section (*q.v.*) is coming to take the place of embryulcia, for it is indicated even when there is reason to dread infection of the uterus. At the present moment it is recognised that the operation of killing a child in order to deliver it is theoretically wrong, and that embryotomy ought therefore to be performed only when there is good evidence that the foetus is already dead or dying; but, in actual practice, a living infant is still occasionally craniotomised, when it is felt that the risks of performing Cæsarean section are too great.

METHODS.—It is not wonderful, therefore, that few contributions have been made to the technique of embryulcia. An operation which is discredited, which is passing out of use, does not attract attention; inventive genius turns away from it in other directions, and it is left to perish without modification. Nevertheless, some suggestions have been made which are of value. The operation of decapitation, for instance, has been rendered easier and more exact by Jardine's modification of Ramsbotham's decapitator, by which it is converted into a decapitating hook (Jardine, *Clinical Obstetrics*, 2nd ed., p. 500, 1905). But there are two operative procedures, greatly facilitating the extraction of the child in embryulcia, which call for more extended notice; I refer to cleidotomy after craniotomy or basilysis and to tapping the cerebral ventricles through the spine in hydrocephalus; both these methods have taken their place of late years among the valuable means of terminating difficult labours.

CLEIDOTOMY.—*Definition and History.*—Cleidotomy or division of the clavicles is an operation accessory to craniotomy or basiotripsy, and it has for its object the diminution of the width of the shoulders of the foetus. It is possible to imagine cases in which it might be performed apart from these other operations, *e.g.* in broad-shouldered anencephalic foetuses, but in the great majority of instances it is simply a rapid means of ending a difficult craniotomy. No doubt obstetricians in the past, when confronted with such an emergency as impaction of the shoulders after birth of the head (either intact or craniotomised), adopted some plan of procedure for the reduction of the width of the bisacromial diameter; but they do not appear to have specialised the manœuvre into a definite operation, nor to have restricted the embryulcia to the clavicles. Dr. H. R. Spencer (*Brit. Med. Journ.*, i. for 1895, p. 808) introduced the operation of cleidotomy, although he did not give it that or any other specific denomination. He said: "It may be necessary to reduce the width of the child's shoulders. With this object I have found it a useful plan to snip through the clavicles with scissors, then, if necessary, to pass a blunt hook into the axilla, and then to bring down the arms." He went on to say that he had met with several cases (five or six) where craniotomy was not sufficient to extract, and had practised the snipping through of the clavicles. Soon after the publication of Spencer's article Professor Phänomenoff of Kasan (*Zentralb. f. Gynäk.*, xix. p. 585, 1895) described the same operation,



giving to it the definite name of cleidotomia ("Durchschneidung des Schlüsselbeins"); and he was led to perform the operation rather because of large size of the foetus (it weighed 13 lbs.) than of contraction of the pelvic canal. The head of the infant was without much difficulty brought down to the perineum with forceps, but no further progress could be made, and the infant died, so Phänomenoff divided both clavicles near their inner end with a pair of scissors (passed up above the brim), and so delivered the child. In the same year Knorr (*Zeitsch. f. Geburtsh. u. Gynäk.*, xxxiv. p. 105, 1896) divided both clavicles with Siebold's scissors after having performed craniotomy; he was much impressed with the immediate effect thus produced, a slight pull sufficing to deliver the trunk. Other contributions to the subject were those of Strassmann (*Arch. f. Gynaek.*, liii. p. 135, 1897), H. A. v. Guérard (*Zentralb. f. Gynäk.*, xxii. p. 71, 1898), E. Bonnaire (*Presse méd.*, No. 21, p. 125, 1900), G. Kallinowsky (*Diss. inaug.* (Berlin), 1898), Rieznikoff (*Yuzhno-russk. med. gaz.* (Odessa), v. p. 425, 1896), and Perondi (*Clin. ostet.* (Roma), ii. p. 133, 1900). Ballantyne described a case and gave an account of the operation at a meeting of the Edinburgh Obstetrical Society in 1900 (*Trans. Edin. Obstet. Soc.*, xxvi. p. 24, 1900-01); he has repeated the operation several times since then.

The *indications* for cleidotomy can hardly be said to be as yet clearly defined. It has not been performed on the living infant, but there are circumstances in which it might be justifiable to do so, *e.g.* in the case of monstrosities, such as anencephalus, double terata, etc. It is generally to be carried out as a sequel to the operations of craniotomy, basilysis, and basiotripsy, but it may be required apart from these procedures. The indications may be roughly grouped under five headings:—(1) It is indicated in the case of the broad-shouldered foetus, where the head also is above the average size (and where, therefore, craniotomy will doubtless have been carried out), or where the head is of normal size or deformed (anencephalus or hydrencephalus), when cleidotomy may be the only operative procedure rendered necessary; (2) it is indicated in cases of contracted maternal pelvis, justo-minor, flat-rachitic, or kyphotic, in which the foetus may be normal in size; in such cases craniotomy is generally performed first and cleidotomy later; in the first and second types of contraction the division of the clavicles must be done at the brim of the pelvis, and in the third, at the outlet; (3) there is a group of cases in which the foetus is large and the pelvis moderately contracted; in these instances it is the association of two difficulties, neither of which is in itself sufficient to cause great delay, which renders cleidotomy necessary; (4) cleidotomy may be advisable in cases of breech presentation in which the shoulders are impacted; and (5) in all cases in which rapid delivery is called for (as in eclampsia, threatened uterine rupture, accidental hæmorrhage), and in which the foetus is either dead or very little likely to survive.

*Technique.*—The operation of cleidotomy can be carried out very easily. The only instrument necessary is a pair of long and strong blunt-pointed scissors. Craniotomy or basiotripsy has been performed, and the comminuted head has been drawn down to the perineum by the cranioclast, basilyst-tractor, or crotchet. Delay now occurs, due to the impaction of the shoulders in the contracted brim of the pelvis. By continued traction the difficulty may possibly be overcome at the risk of injury to the maternal structures, and with the loss of valuable time, and the expenditure of much force. To prevent this delay and



these dangers, division of one or both clavicles is enough. If the head be lying with the occiput to the front, it is drawn well forward; the operator then slips his left hand up the vagina over the face of the child till he feels the clavicles projecting from the thoracic wall at the level of the pelvic brim, then he insinuates the scissors, held in the right hand, between his left hand and the child, until he is able to grasp the clavicle of one side between their points, and then with a strong snip he divides the bone near its inner end. The process may be repeated on the clavicle of the opposite side. Munro Kerr (*Operative Midwifery*, p. 506, 1908) uses straight scissors or a symphysiotomy knife, such as Pinard's. The immediate result is an astonishing collapse of the shoulders, and the extraction of the infant's trunk with very little further effort, or, at the most, with the help of traction with a blunt hook upon the axilla. The only case in which Ballantyne met with any difficulty was one in which the foetus had a marked degree of ossification of all the bones, and particularly of those of the cranium and shoulder girdle (*Green's Ency. and Dict. of Medicine*, v. p. 296, 1907). If the contraction of the pelvis be at the outlet, the procedure is not materially altered, indeed it is simplified; and in the case of the anencephalic foetus the small size of the head allows the operator's hand easily to reach the infant's clavicles at or above the brim.

*Advantages.*—If we compare cleidotomy with the only other procedures possible under the circumstances, it will become at once apparent that it excels them all. It must, for instance, be better than *simple traction* on the craniotomised head of the infant, with the loss of time, the risk of injury to the mother's parts, and the danger of separation of the head from the trunk of the child, which all accompany that method of trying to overcome the delay. Then *cleidotripsy*, or the breaking up of the clavicles and the tissues of the shoulders with a perforator or basilyst, is an awkward procedure, not easy of accomplishment; it is quite unnecessary also, for simple division of the clavicle is all that is needed. *Cleidorrhexis* is a sort of bruising or breaking of the shoulder-girdle carried out of set purpose, and performed by some obstetricians (e.g. A. Müller, *Monatssch. f. Geburtsh.*, viii. p. 477, 1898). It is used in cases in which the body of the child is born and in which the shoulders and head are still at or above the brim, and it consists in carrying the trunk first forward and then backward, until the shoulder girdle gives way and moulding occurs. *Supra-acromiotomy* is another operative procedure, and has been described by Bonnaire. It consists in a localised embryotomy, by which the skin and muscles covering the projection of the shoulder are divided widely and deeply; but it is not an exact operation, although it may conceivably be useful in cases in which the clavicles cannot be reached. It is quite evident that cleidotomy has advantages over all these competitive procedures. The division of the clavicles at once, and very materially, reduces the bisacromial diameter, by allowing the shoulders to collapse; indeed the clavicles alone keep the shoulders apart. It has been found by experiment that there is a diminution of the bisacromial diameter by 2 and 3 cm. in unilateral and bilateral cleidotomy respectively. This narrowing of the shoulders either permits them to enter the pelvic cavity, or gives room for the passage of a blunt hook upwards, and for the fixing of it in the axilla to make traction. Division of the clavicles is the one thing necessary, and cleidotomy alone of all the proposed plans does this and no more. It is simpler, more rapid, much more elegant, and it is



quite as effective as any of the other operative procedures: it is, further, founded upon the correct scientific principle of attacking the parts which are concerned in maintaining the breadth of the shoulders. The cause of delay in labour in these cases is the width of the shoulders in the bisacromial diameter; by cleidotomy this diameter is quickly diminished, and with practically no risk to the mother.

**SPINAL TAPPING** (*Paracentesis*).—Like cleidotomy, spinal paracentesis is a scientific and elegant method of overcoming a difficulty in labour which is often attacked by force, ill-regulated, misapplied, and excessive. What cleidotomy does for the delivery of the shoulders after craniotomy or basilysis, spinal paracentesis may do for the extraction of the after-coming hydrocephalic head.

*History*.—So long ago as 1848 the procedure of tapping the spine for the delivery of the hydrocephalic foetus was proposed by Vanhuevel (*Presse méd. belge*, i. pp. 279, 343, 1848-9), and it was actually carried out by Tarnier in 1868 (*Traité des Accouchements*, iv. p. 32, 1901), although Hubert (*Cours d'accouchements*, ii. pp. 254, 268, 1878) claims for Lacoux the honour of establishing it as a useful obstetric operation. Charles used the method successfully (*Journ. d'accouch.* (Liège), ii. p. 41, 1881), as did Ira G. Stone in 1897 (*Med. News* (New York), lxx. p. 302, 1897), and Pozzoli (*Lucina* (Bologna), iv. p. 167, 1899), in 1899. Oui (*Arch. de tocol.*, xviii. p. 617, 1891) failed to carry out the manœuvre because of fracture and displacement of the cervical spine, which prevented the passage of the sound through the spinal canal into the cranium. In Great Britain Ballantyne seems to have been the first to report a successful case (*Brit. Med. Journ.*, ii. for 1904, p. 1567), and to put a second one on record soon afterwards (*Trans. Edin. Obstet. Soc.*, xxxi. p. 66, 1905-6); but Dougall (*Glas. Med. Journ.*, xvi. p. 25, 1881) seems to have thought of reaching the cranium through the spinal canal in a case of hydrocephalus with spina bifida, using the one complication (the bifid spine) to obviate the other (the hydrocephalus), although he did not put his proposal into effect.

*Indications and Technique*.—The indications for tapping the foetal cranium by way of the spinal canal are hydrocephalus (when the breech of the child has presented and been born, the large head remaining above the brim of the mother's pelvis) and any other condition (*e.g.* encephalocele, meningocele, etc.) in which the head is distended with fluid which can be reached by the spinal canal and in which the body of the child is already born. Of course there is another way of dealing with hydrocephalus or encephalocele when the head itself presents. Cases of delay in the birth of the breech due to the presence of a large sacral meningocele might possibly also be treated by spinal paracentesis; under these circumstances the foetal head would be expelled, and the catheter would be introduced and passed along the spine towards the sacrum instead of in the direction of the head. The technique, as described by Ballantyne, may be given. In the first case, the patient was sent into the Edinburgh Royal Maternity Hospital with her baby born as far as the shoulders. It had been a transverse presentation, and the doctor in attendance had performed version and brought down the feet, but neither his exertions nor those of another medical man who came to his aid sufficed to complete the delivery. When Ballantyne saw the patient she was in a very collapsed state (pulse 140, thready, etc.), there were no pains, and the uterus was as large as it is at the beginning of labour, notwithstanding the fact that the feet and lower



part of the trunk were outside the vulva; he made the provisional diagnosis of hydrocephalus or of some other cephalic malformation. With an ordinary scalpel he made a transverse incision over the interspace between the 6th and 7th dorsal vertebræ in the interscapular region; no fluid appeared; so he next took a long silver catheter with several openings in its distal end, and insinuated it into the spinal canal, bending the back of the infant at the time so as to make the spinal curves and those of the catheter coincide; then, turning the point of the catheter forwards as it lay in the cranium, he had the satisfaction of seeing clear fluid running out of it. Thirty-six ounces of fluid were thus removed, when the birth of the head and shoulders of the infant was completed with perfect ease. In Ballantyne's second case the procedure was even simpler, for the presence of a spina bifida in the lumbar region did away with the necessity of opening into the spinal canal; the catheter was pushed up through the defect in the vertebral column, reached the cranial cavity, and gave egress to the large quantity of fluid collected therein. In the first case the child weighed twelve pounds and in the second more than ten pounds. Both the mothers made good recoveries. It will probably be found to be necessary always to use a catheter made of metal, or to pass a sound up through a soft catheter to make it rigid (as Stone did), for Ballantyne refers to a case in which a rubber catheter was tried and failed to reach the fluid.

*Advantages.*—The advantages of spinal tapping for the delivery of the after-coming head in hydrocephalus are obvious. There is (1) the advantage of operating upon parts which are external and visible; there is (2) the small armamentarium required, a knife and a catheter; there is (3) the rapidity and completeness of the evacuation of the cranium thus obtained; and there is (4) the avoidance of any further internal interference with hands or instruments when all such interference is necessarily fraught with danger, for it is by no means an easy or a safe procedure to perforate a hydrocephalic head behind the ear or through the occiput when that head is at or above the pelvic brim. By spinal tapping a grave obstruction existing above the pelvic brim is overcome by a simple operation performed outside the vulva.

**Endocarditis.**—Attention has lately been directed by Osler and Horder to the existence of a chronic form of infective endocarditis, associated with the presence of organisms in the blood stream, which may run a course of many months accompanied by few symptoms save pyrexia; which is difficult of diagnosis; and which is apparently invariably fatal. The condition must be distinguished on the one hand from malignant, or ulcerative, endocarditis (which is really an acute septicæmia with localisation in the endocardium), and on the other from chronic rheumatic endocarditis, in which protracted fever may occur. The lesion characteristic of chronic infective endocarditis is the presence of large proliferative vegetations on the valves and chordæ tendineæ, with none of the ulceration met with in acute cases. According to Horder the essential symptoms on which a diagnosis may be founded are: (1) the presence of valvular disease, (2) the occurrence of emboli, and (3) the detection of organisms in the blood. Any two of these make the diagnosis extremely probable.

Chronic infective endocarditis usually occurs in persons already suffering from a valvular lesion. The disease begins insidiously, some-



times with chills, and when once the fever is established it becomes the dominating symptom—"week after week, month after month, the daily rise of one and a half to two degrees may be the only indication there is of the existing mischief" (Osler). The temperature is remittent, and not very high— $102.5^{\circ}$  to  $103^{\circ}$ . Apart from the already existing signs of valvular disease there may be no symptoms referable to the heart until towards the close of the illness. Notwithstanding the infection the murmurs may undergo no alteration. Emboli are common. An interesting peculiarity is the occurrence of ephemeral spots of painful nodular erythema, chiefly on the skin of the hands and feet—the pads of the fingers and toes, the thenar and hypothenar eminences, the sides of the fingers, and the lower parts of the arms are favourite sites. Petechial eruptions are also common. These cutaneous lesions are due to emboli. The patients suffer from progressive anæmia, leucocytosis is scanty or absent, albuminuria occurs in about one third of the cases. Dr. Norman Moore draws attention to a peculiarly sanguine frame of mind as characteristic of the disease. Even where, as has happened, the patient has himself been a medical man, it may be impossible to induce him to take a serious view of his condition, although organisms have been demonstrated in his blood. The diagnosis of chronic infective endocarditis is not easy; it may readily be mistaken for tuberculosis or malaria. Osler gives as the most suggestive features: (1) an old-standing valve lesion; (2) the occurrence of emboli (*e.g.* sudden enlargement of the spleen, or pains in the loin and hæmaturia); (3) the cutaneous symptoms; (4) alterations in the murmurs and dilatation of the heart.

*Etiology.*—This has been carefully worked out by Horder, not only as regards chronic, but as regards acute cases. He attaches great importance to blood cultures in coming to a diagnosis, and states that with a proper technique positive results can be got in 90 per cent. of cases. In 40 cases of infectious endocarditis in which an organism was isolated from the blood during life, streptococci were found 26 times, Pfeiffer's bacillus 5 times, pneumococci 5 times, gonococci twice, unclassified once, staphylococci once. The streptococcus, therefore, is the prevalent organism, and the interesting point brought out by Horder is that it is especially the less virulent strains of the organism which are met with. Horder distinguishes five types of streptococci—*s. pyogenes*, *pneumococcus*, *s. faecalis*, *s. salivarius*, and *s. anginosus*. The last three are closely allied to the saprophytic streptococci of the alimentary tract; they are of low virulence, not being pathogenic to mice, and yield bio-chemical reactions which differentiate them sharply from *s. pyogenes*. Horder associates these characteristics of the causal organism with the following clinical facts:—(1) The chronicity and latency of the disease; (2) the occurrence of afebrile periods; (3) the absence of suppuration in embolic infarcts; (4) the scanty or absent leucocytosis; (5) the absence of any visible focus of infection; (6) the enormous number of organisms which may exist in the blood without causing any grave symptoms.

*Prognosis.*—Chronic infective endocarditis is probably always fatal. Though the organism is of such low virulence, this very fact shows that for it to have gained a lodgment in the body the patient's defensive powers must have been correspondingly poor. The duration of the disease may be several weeks or months after a positive diagnosis has been made by blood culture. *Treatment* by chemical antidotes, by antibacterial



serums, and by vaccines, has proved quite unsuccessful. In many cases the opsonic index is high though the patient is obviously going downhill, and this rather militates against the idea that vaccines will do good. Horder advises that a polyvalent antistreptococcus serum should be tried by intravenous injection. As a precaution, oral sepsis should be treated, especially in persons with valvular disease.

REFERENCES.—OSLER. *Quarterly Journ. of Med.*, Jan. 1909.—HORDER. *Ibid.* April 1909.

**Enterogenous Cyanosis.**—The coexistence of chronic cyanosis and intestinal disorder was first described by Stokvis and Talma, and subsequently by Hymans van den Bergh. In 1908 G. A. Gibson proved that the cyanosis was due to the activity of micro-organisms, and gave to it the name of *microbic cyanosis*. In all the recorded cases the cyanosis has been very pronounced, but nevertheless it gives rise to little or no discomfort. It may last for years, and is sometimes associated with clubbing of the fingers; hyperglobulia, however, has not been reported. In all cases, too, there has been a history of chronic gastro-intestinal disorder, generally diarrhoea, and often putrid stools. The blood shows the characteristic spectrum of methæmoglobin (q.v. *Encyclopædia Medica*, Vol. XI. p. 265), though in one case sulphohæmoglobinæmia is said to have been present. That a connection exists between the cyanosis and the intestinal disorder has been repeatedly proved by the effect of treatment; in one patient the cyanosis disappeared so long as the diet was restricted to milk; in others, cure of the diarrhoea has ameliorated or even abolished the cyanosis. Van den Bergh proved that during the existence of the cyanosis the blood contained nitrites, but while he thus demonstrated the cause of the methæmoglobinæmia, he left the source of the nitrites an open question. Gibson and Carstairs Douglas confirmed and amplified his observation. They found that while nitrites were present in the blood, they were absent from the intestinal contents, and that the fæces were devoid of power to convert normal hæmoglobin into methæmoglobin. Having thus excluded the possibility of an absorption of nitrites from the bowel, they conjectured that these must have a hæmatogenous origin. Further research showed that an organism of the colon group could be isolated from the blood. Gibson therefore regards microbic cyanosis as a systemic affection arising from the bowel, with the continuous production in the blood of varying amounts of nitrites, which convert part of the hæmoglobin into methæmoglobin.

LITERATURE.—HYMANS VAN DEN BERGH. *Deutsche Arch. f. klin. Med.*, Bd. 83, p. 86, 1905.—GIBSON and CARSTAIRS DOUGLAS. *Lancet*, 14th July 1906.—GIBSON. *Quarterly Journ. Med.*, Oct. 1907.

**Erythema Infectiosum and Other Doubtful Exanthemata.**—Everybody is agreed as to the existence of three well-defined diseases—scarlet fever, measles, and German measles; there is, however, some reason to think that there are one, if not two, other eruptive fevers which resemble, and may at times simulate, these. The "Fourth Disease" was independently described by Dukes, of Rugby, and Filatow, of Moscow; hence it is known in Germany as "Filatow-Dukesche Krankheit." Its characteristic features are described by Dr. Dukes in his article SCARLET FEVER in the *Encyclopædia Medica*. Since Dr. Dukes's original papers on the subject appeared, there has



been no substantial advance in our knowledge of Fourth Disease, and its existence is still *sub judice*.

A fifth eruptive fever of this type was described by Pospischill in 1904. It is said to have occurred in epidemic form in Vienna. The main characteristics of the eruption are that while on the arms, legs, and trunk it tends to remain macular, on the face the spots coalesce, and give rise to large patches of erythema on the cheeks, over which the skin is hot to the touch, tense, and glistening. The rash is practically the only symptom. There is neither exanthem, glandular enlargement, strawberry tongue, nor desquamation. The incubation period is believed to be from six to fourteen days; children are most liable.

Apparently erythema infectiosum (as the new disease is called) has not been recognised in epidemic form outside Vienna. It is of interest to note that in 1902 Dr. Ker expressed the opinion that there might be a new disease apart from measles, German measles, and scarlet fever, though he was not prepared to accept Dukes's "Fourth Disease" as demonstrated. Shaw (to whose paper a plate of erythema infectiosum is appended) states that the disease is more like German measles than any other of the exanthemata, and that it may be the disease heralded by Ker.

REFERENCES. — KER. *Practitioner*, Feb. 1902. — POSPISCHILL, *Wien. klin. Wochensh.*, No. 25, 1904. — SHAW. *Amer. Journ. Med. Sci.*, Jan. 1905.

## Eugenics.

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DEFINITION AND HISTORICAL NOTE.—Eugenics is the science of well-begetting or good-breeding; it has to do with the production of fine offspring, especially in connection with the human race; it encourages parenthood on the part of the worthy, and discourages it on the part of the unworthy; and so, inferentially, it would refuse the right to propagate, the right to become a parent, to the unfit. In 1883 Mr. (now Sir) Francis Galton, in his book entitled *Human Faculty* (p. 44), seems first to have used the term *eugenics*, writing, as he then did, of "the investigation of human eugenics, that is, of the conditions under which men of a high type are produced." *Eugenism*, according to the same author, is "the aggregate of the most favourable conditions for healthy and happy existence." It cannot be said that the new science took much hold upon the mind of the nineteenth century, provoking, as it was bound to do, the retort that "people will fall in love, in spite of your eugenics;" but the early years of the twentieth century have witnessed an active propaganda consisting in the establishment of a Francis Galton Laboratory for National Eugenics in connection with the University of London, in the publication of *Eugenics Laboratory Memoirs*, in the formation of the Eugenics Education Society, and in the appearance (in April 1909) of the first part of the *Eugenics Review*. The movement, therefore, is now fully equipped, and it has further received, through its originator, the stamp of royal approval in the knighthood bestowed upon Mr. Galton. Sir Francis Galton is cordially to be congratulated on the progress which the science has made, as shown by this public recognition of its aims and object. In Germany there is a somewhat similar movement with a journal entitled the *Archiv für Rassen- und-Gesellschafts-Biologie*, the scope of which is somewhat wider than



that of eugenics; and in the United States of America the consideration of the betterment of the race has proceeded to its logical conclusion, the sterilisation of the unfit, and the State of Indiana has passed an Act for "the sterilisation by the knife of confirmed criminals, idiots, imbeciles, and rapists, and has fixed the maximum fee of the medical experts consulted" (*Lancet*, ii. for 1907, p. 40). There is, therefore, a world-wide tendency to focus attention upon antenatal matters, and to take thought how what is wrong before birth may be put right, and how what is right may be encouraged. The *British Medical Journal* (vol. ii. for 1901, p. 1363) may here be quoted:—"The way in which, at certain epochs, different minds, starting from very different points, work towards the same conclusion is a remarkable phenomenon. It has given rise to many charges of plagiarism and some bitter controversies as to priority. . . . An instance of the phenomenon is afforded by the interest just now shown in the possibilities of puericulture. French philosophers, whether sociologists or physicians, have been driven to a study of the subject by the hard facts of vital statistics, which show that the population of France has become practically stationary owing to a great decline in the birth-rate. Dr. Ballantyne and other leaders of the Edinburgh school of obstetricians have been brought to the subject by a consideration of the needs of pregnant women for better treatment during the time they are with child. Sanitarians have been led to consider similar questions from an observation of the lamentable results on the offspring of women's labour during the latter months of pregnancy. Now we have Mr. Francis Galton bringing his analytical methods to bear on the question in the ingenious and suggestive Huxley Memorial Lecture which he delivered before the Anthropological Institute of Great Britain and Ireland. . . . The aim of the lecture was to give a scientific basis to the problem of race improvement under existing conditions of civilisation and sentiment." Eugenics, therefore, must be regarded as one of the lines of approach to the great problem of antenatal health and well-being; it emphasises the hereditary aspect of the subject, and would utilise the existence of favourable traits in individuals, and their intensification by regulated marriages for the progress of race-culture. Antenatal pathology and hygiene has its attention directed more immediately to the discovery of the causes of antenatal disease, malformation, and deformity, and to the possible prevention of such by treatment given to the mother during her pregnancy, or to both parents at and before the occurrence of conception. Puericulture studies not only the antenatal side of the question, but also proceeds upon the assumption that much may be done to better the race by improving the sanitary conditions into which babies are born, and by saving the new-born child from erroneous feeding in an unhygienic environment. It is quite obvious that all these different lines of approach have before them the common goal of race betterment and the prevention of race-suicide; but, at present, there is a strange lack of united effort, which is not a good augury of early success.

SCOPE AND OBJECTS.—As has been indicated, eugenics deals with the hereditary side of the problem of race-culture; it studies the laws of heredity, so far as they are known, and endeavours to draw deductions from them which shall be helpful in suggesting the lines along which regulation of marriage should proceed and the degree to which the segregation or sterilisation of the unfit should be insisted upon. In this sense it is preventive medicine applied to the organism in the germinative stage of antenatal life; the best germ cells are to be brought together,



and those which carry in them a hereditary blight are to be prevented coming to fruition. It includes, therefore, the subject of germinal therapeutics, as looked at from the standpoint of heredity. But, in a larger sense, it deals with influences which are not strictly hereditary, with alcoholism and syphilis, for instance, which are germinal or foetal diseases or infections, and with tuberculosis, which "lies very near the line between heritable and non-heritable diseases." The sciences of eugenics and antenatal pathology here overlap to a very marked degree; and both have as their aim the attainment of antenatal health by the discovery of the causes of disease which come into action during the antenatal life of the individual, and by finding out means of preventing them so acting. Such is the "eugenic field" in its widest expanse (see Crackanthorpe, *Eugenics Rev.*, i. pp. 11-25, 1909); but in its more limited range it includes simply *positive* eugenics, or the encouragement of parenthood on the part of the worthy, and *negative* eugenics, or its discouragement on the part of the unworthy, selection and rejection (Saleeby, *Eugenics Rev.*, i. p. 8, 1909). It is a wide field, whether we consider it in its limited or in its more extended aspect. Further, the subject of eugenics can hardly make its influence felt without at once coming into touch, and, it may easily be, into conflict with the law, social customs and institutions, and religion. It is, of course, eminently desirable that emigrants going to a new colony should be healthy members of a good stock, so that their children may worthily carry on the work their parents are about to commence; it is very important that persons predisposed to tuberculosis, or the victims of the craving for alcohol or drugs, or the subjects of epilepsy, deafmutism, congenital blindness, or hæmophilia should not marry or intermarry; but the law, social customs, and the rules of the Church must be altered before a health certificate can be demanded from all intending emigrants or candidates for matrimony, on pain of refusal of permission to embark on the Atlantic Ocean or on the no less uncertain sea of matrimony. A people which resents interference with the liberty of the subject to such an extent as to demand and secure the conscientious objector's exemption in the case of vaccination, is not likely to allow its rights to choose a mate to be abrogated at the bidding of the Eugenics Education Society. At the same time, the medical profession ought to support Sir Francis Galton and his assistants in their effort to make generally known the aims of eugenics. These are: "Persistently to set forth the national importance of eugenics in order to modify public opinion, and create a sense of responsibility in the respect of bringing all matters pertaining to human parenthood under the domination of eugenic ideals; to spread a knowledge of the laws of heredity, so far as they are surely known, and so far as that knowledge might affect the improvement of the race; and to further eugenic teaching, at home, in the schools, and elsewhere." It is when the "eugenicist" attempts to go beyond the education of public opinion that an element of doubt obtrudes itself; it is one thing to educate and quite another to coerce. The regular and systematic teaching of heredity and antenatal pathology and hygiene in universities may also be commended; and no objection need be urged against the proposal made by Mr. Eden Phillpotts and seriously supported by Havelock Ellis (*New Age*, 7th March and 11th April 1908), that there should be a State Department for the unborn, although it is difficult to imagine such a bit of Government machinery in being. "The Department would be entirely devoted to the interests of the next



generation; it would have nothing to say concerning marriage, but as soon as men and women set about becoming mothers and fathers they would have to reckon with this Department." Here again the idea of compulsion, of strong suasion at least, comes in, and the world is hardly ready for this. With a falling birth-rate and the national anxiety engendered thereby, it is futile for eugenisists to insist that "there are circumstances in which the number of the family should be kept within reasonable limits;" but it is perfectly right that, since the supply of babies is lessening year by year, every effort should be made to bring them into the world healthy and keep them in life when they arrive. It is hardly the time to advise a further reduction of the supply. When the laws of heredity are known with such exactness that it can be foretold with reasonable certainty that the offspring of this or that union will be of little or no civic worth, then it may be permissible to advise a self-induced sterility; in the meantime, no such confident predictions can be made whilst, on the other hand, much can be done to prevent abortions and premature labours, and to benefit the unborn infant by helping his mother to keep from alcohol and by saving her from hard work and bad hygiene during pregnancy. With regard to the hope that eugenics may succeed in bringing into the world a large number of truly great men, time alone can tell; but it may be said that the genesis of the great man, of Dante, or Shakespeare, or Goethe, or Carlyle, or Lister, is still a mystery, apparently ungoverned by the known laws of heredity, and inexplicable by the circumstances which immediately precede his birth. He comes unheralded, and most frequently he leaves no trace of his greatness, either in his immediate or his remote descendants.

LITERATURE.—BALLANTYNE. "Antenatal Therapeutics" and "A Petition from the Unborn," *Brit. Med. Journ.*, i. for 1899, pp. 889-893.—GALTON. "Eugenics," *Med. Times and Hosp. Gaz.*, xxxii. p. 321, 1904.—REID, G. A. *Lancet*, i. for 1904, p. 1685.—GALTON. *Nature*, lxxi. p. 401, 1904-5.—GALTON. *Amer. Journ. Sociol.*, xi. pp. 11-25, 1905-6.—Editorial, *Lancet*, i. for 1905, p. 1009.—Letter, *Lancet*, i. for 1907, p. 191.—GALTON. *Pop. Sc. Month.*, lxxi. pp. 165-178, 1907.—PEARSON. *Ibid.*, lxxi. p. 385, 1907.—Various articles in *Eugenics Rev.*, i. Nos. 1 and 2, 1909, and in *Eugenics Laboratory Memoirs*, Parts i.-vi., 1908-9.

**Favus.**—Favus of the scalp should be treated by X-rays in exactly the same way as described under tinea capitis; but in this disease the application of X-rays is essential if the disease is at all extensive. As the disease itself causes permanent baldness, one does not hesitate to reapply the rays soon should the first exposure not cause epilation.

**Fibrolysin.**—Fibrolysin is the name given by Merck of Darmstadt to a preparation of thiosinamine. It is prepared from oil of mustard, and occurs in colourless rhombic crystals of bitter taste and garlic odour. It is a therapeutic remedy that is at present being widely used in cases where it is desired to soften cicatricial tissue. Von Hebra in 1892 published some of the results he had obtained by the therapeutic use of thiosinamine. He employed it in 15 per cent. alcoholic solution as an injection for the treatment of lupus and cutaneous scars. Beneficial results followed, but the treatment was open to this objection, that the injection of the alcoholic solution was exceedingly painful: the drug was unstable and insoluble in water. These drawbacks have been remedied by the modification suggested by Dr. Felix



Mendel, of Essen, who, by combining one molecule of thiosinamine with a  $\frac{1}{2}$  molecule of salicylate of soda, formed a white crystal powder, to which the name of fibrolysin has been given. This substance is absolutely non-irritant, so that injections of it are consequently painless and are found to be harmless. The preparation is put up in aqueous solution of 15 per cent. strength, in sterile glass ampullæ, each containing 2·3 c.c. This represents ·2 gram (3 grs.) of pure thiosinamine.

PHYSIOLOGICAL ACTION OF FIBROLYSIN.—The injection of fibrolysin into the tissues is followed by a temporary pronounced diminution of the leucocytes in the blood. This diminution is, however, followed by a great excess of white blood corpuscles. It is also claimed for it that red cicatricial tissue, as for example that resulting from a recent burn, will become paler and turgid and more flexible, so that movement of the part can be carried out more freely. It is also said that the injections of fibrolysin determine greater activity of lymph flow in the scar tissue. Inflammatory bands loosen and soften. Exudation material dissolves and is absorbed. Individual connective tissue fibres appear swollen, their outline blurred, and the nuclei more distinct. This action of fibrolysin is claimed to be specific for fibrous tissue of pathological origin, tending to cause its ultimate disappearance.

From the few facts concerning the action of fibrolysin that have been mentioned, it will be seen that, if it possesses anything like all the properties that are claimed for it, it is a drug whose action is unique, and whose therapeutic application is extremely wide.

Fibrolysin has been used in a great variety of diseases, such as cicatricial contracture following after a burn, Dupuytren's contracture, keloids, œsophageal and pyloric stenosis, post-operative abdominal adhesions, stricture of the urethra, etc., etc.

METHOD OF ADMINISTRATION.—The drug is administered by hypodermic injection. The most satisfactory method is by intra-muscular injection into the buttock. It may be injected between the shoulders or into the biceps muscle. Those who have used this drug and obtained satisfactory results in cases such as Dupuytren's contracture, or contractures following burns, find that the best results are obtained by direct injection into the tissues at the site of the lesion. This latter method is, however, usually more difficult to carry out, and accompanied by slight discomfort. Where the former methods are practised, the injections are accompanied by absolutely no pain or discomfort, apart from the prick of the needle. Intravenous injection may be employed, when it is desired to obtain the effect of fibrolysin with greater speed. Occasionally a patient is met with who possesses an idiosyncrasy towards the drug, and the injection of it is found to be followed by headache, faintness, and drowsiness on the day after the injection. Slight feverish reaction is occasionally met with. In order to obtain its beneficial effects, it is necessary that repeated injections be administered. These may be given every second day, 15, 20, or even 50 individual administrations being given. When a large number of injections are being given, it is advisable, however, that the interval be longer than that above mentioned.

In estimating the true value of fibrolysin, there are certain difficulties that confront one at the outset. The pathologist is somewhat at a loss to explain the specific selective action which the drug is claimed to possess towards fibrous tissue. On the other hand, it is always extremely difficult to exclude the operation of concomitant factors



which may contribute towards an improvement of the part under treatment, as, for example, the gradual stretching of the palmar fascia which is brought about by the patient massaging the part to test whether it has become softer or not, and extending the finger to test whether any lengthening in the fibres has taken place. It is still a fact that cannot be gainsaid that certain surgeons of wide experience and undoubted integrity have obtained most astonishing results from the use of this remedy. Thus cases are met with—to return to the illustration of Dupuytren's contracture already taken—where cure has followed its use in this disease after many other remedies had been tried without success.

Sufficient time has not yet elapsed to enable a final judgment to be given on the value of fibrolysin in the practice of medicine. At present all that can be said is this, that in many diseases it would be well to try the efficacy of this remedy before embarking upon more serious treatment.

### **Gall Bladder and Bile Ducts, Diseases of.—**

The principal advances which have been made in our knowledge of this group of diseases have been in the direction of bringing into prominence the relation which some of them bear to chronic interstitial pancreatitis. The credit of this work rests chiefly with Mayo Robson and Cammidge, the latter of whom has introduced a method of examining the urine which gives information as to the condition of the pancreas. The Cammidge reaction, and the questions of chronic pancreatitis are discussed in the article on DISEASES OF THE PANCREAS, and only the main points related to diseases of the biliary passages will be referred to here.

The common bile duct opens into the lumen of the duodenum about 3 inches from the pylorus by an orifice (the ampulla of Vater) common to it and the duct of Wirsung. In 60 per cent. of cases (Robson) the bile duct passes through the head of the pancreas in its course to the ampulla, and in some cases, instead of the duct of Wirsung and the bile duct opening separately, the pancreatic duct opens into the bile duct. Mayo Robson believes that the above relationship of the common bile duct to the head of the pancreas affords an explanation of many cases of so-called catarrhal jaundice: according to him the disease is frequently due to swelling of the head of the pancreas compressing the common duct in its course through it. Chronic catarrhal jaundice may also be caused by interstitial pancreatitis. The diagnosis between this condition, and malignant disease of the pancreas, which it closely resembles, can be made by the Cammidge reaction and by examining the stools for neutral fats. Unlike cancer, the condition is curable by cholecystenterostomy.

Another result of the close relationship of the biliary and pancreatic ducts is the liability of infection to spread from the bile duct to the pancreas. If an infective cholangitis occurs, as is often the case when impacted gall-stones are present, chronic, subacute, or even acute pancreatitis may be produced. So commonly is pancreatic inflammation associated with common duct cholelithiasis of old standing, that when the diagnosis is in suspense between cholelithiasis and cancer of the head of the pancreas, great help may be derived from an examination of the urine for Cammidge's pancreatic crystals, and of the motions for excess of neutral fats. The presence of these is in favour of pancreatitis and against malignant disease.

REFERENCES.—MAYO ROBSON. *Edin. Med. Journ.*, Dec. 1905; *Lancet*, 19th March to 2nd April 1904. See also under PANCREAS.



**Gastric Ulcer.**—The Lenhartz method of treating gastric ulcer has had a considerable vogue, especially in Germany. It was introduced in 1904, and has as its special features these objects:—(1) To nourish the patient sufficiently to improve his general condition, and thereby promote the healing of the ulcer. (2) To limit the size of the meals, and thereby avoid distension of the stomach. (3) To prevent the action of the excess of hydrochloric acid on the ulcer by supplying enough albuminous food to “fix” the acid.

The details of the treatment are as follows:—Concentrated foods—eggs, milk, raw beef juice, are given by the mouth in small amounts at intervals of an hour. Slow mastication is secured by feeding with a teaspoon, and never allowing the patient to feed himself. An icebag is applied to the epigastrium if there is any hæmorrhage, and bismuth subnitrate is administered. A “cure” lasts for two weeks, and the patient is kept absolutely at rest for four weeks. The following schedule of diet is given by Lambert:—Eggs to be beaten and kept on ice. Feeds every hour, milk and egg alternately.

Day.	Eggs. Per dose.	Milk. Per dose.	Sugar.	Scraped Beef.
1	2 drachms	4 drachms	...	...
2	3 ”	6 ”	...	...
3	$\frac{1}{2}$ oz.	1 oz.	20 grams added to eggs	...
4	5 drachms	$1\frac{1}{2}$ ”	”	...
5	6 ”	14 drachms	30 grams	...
6	7 ”	2 oz.	40 ”	36 grams in three doses
7	4 ” also 1 soft-boiled egg every four hours	$2\frac{1}{4}$ ”	”	70 grams with 100 grams boiled rice in 3 doses
8	”	$2\frac{1}{2}$ ”	”	”
9	”	3 ”	”	” plus 40 grams rusk
10	”	”	”	” plus chicken 50 grams and but- ter 20 grams
11-14 Interval of feeding 2 hours. Milk given in 6 oz. doses with $\frac{1}{2}$ oz. raw egg. Butter increased to 40 grams, and various additions made (broiled chop, toast, and other cereals instead of rice).				

Lambert's series of cases warrants him in concluding that the original claims of Lenhartz are correct: “First, that the cure is at least equally as efficient as the older method, and that it does not deplete the patient; second, that the cure is more rapid, as well as more certain; third, that the vomiting and bleeding stop more quickly, and relapse less frequently, than in the Leube cure (starvation and rectal feeding); fourth, that the pain ceases promptly and that morphine is never needed; fifth, that the food supply is sufficient throughout; sixth, that it is possible to treat the anæmia earlier with iron and arsenic than in the Leube cure; and seventh, that it is possible to return to a full diet and to the patient's usual occupation earlier than in the older cure.”

Ewald, whose authority on all matters connected with gastric disorders is indisputable, does not, however, think that the Lenhartz treatment gives better results than the classical method of rest, starvation, and rectal feeding.

REFERENCES. — LAMBERT. *Amer. Journ. Med. Sci.*, Jan. 1908. — EWALD *Deutsche med. Wochensch.*, p. 361, No. 9, 1908.



**Graves' Disease.**—**PROGNOSIS.**—In this disease there is a reduction of the polynuclear leucocytes, and an increased proportion of lymphocytes. Kocher regards a marked lymphocytosis as an unfavourable sign. **TREATMENT.**—A number of attempts have been made to prepare a specific remedy for this disease, but the results, on the whole, have not been particularly successful. The preparations which have been most widely used are Moebius's antithyroidin, rodagen, and thyroidectin. Moebius's serum is obtained from sheep and rams from which the thyroid gland has been removed; thyroidectin is the dried serum of thyroidectomised sheep, while rodagen is the dried milk of thyroidectomised goats, with 50 per cent. of milk sugar added as a preservative. Fresh thyroidectomised goat's milk has also been used. A great number of reports of cases treated with one or other of these preparations have been published, and in a considerable number favourable results are claimed. The remedies are in all cases given by the mouth; Moebius's serum is too irritating to be used subcutaneously. Rodagen is given in doses of two grams thrice daily; as a rule it produces no bad symptoms, but it may cause the pulse to become excessively slow, so that its effects must be carefully watched. It is an expensive remedy. The rationale of the use of these drugs is that the serum of a thyroidectomised animal contains substances which should normally be neutralised by the secretion of the thyroid; hence they can neutralise the excessive thyroid secretion which is supposed to cause the symptoms of exophthalmic goitre.

Of greater interest, however, are the attempts to produce a thyrotoxic serum. Murray tried to do so by injecting thyroid into animals, and by feeding, but his results were inconclusive. The most extensive work in this direction has been done by Beebe. He injects the nucleo-proteids of the thyroid, not the whole gland, because if the whole gland be used the serum which is obtained is not purely thyrotoxic, but hæmolytic as well. Rogers has used Beebe's serums clinically. He obtained favourable results with serum from fresh thyroids of patients with exophthalmic goitre, from nucleo-proteid, and from thyroglobulin of the same, but not with that derived from normal human thyroid. In their later papers, Beebe and Rogers express a preference for a serum made by injecting both the nucleo-proteid and thyroglobulin into rabbits, dogs, and sheep. The serum obtained is cytotoxic, and perhaps antitoxic. Their statistics include 90 cases, with 23 recoveries, 52 improvements, 11 failures, and 4 deaths. In a favourable case a reaction follows the injection of the antiserum:—1. At times an "early reaction" occurs with faintness, cyanosis, and other rather alarming symptoms. This is rare. 2. The other reaction is more constant, and occurs about 12 hours after the serum is injected. There is redness and œdema at and around the site of injection, with fever and tachycardia. A second dose of serum should not be given until this reaction has subsided.

**LITERATURE.**—KOCHER. *Arch. klin. Chir.*, Bd. 87, p. 131.—HALLION. *Presse méd.*, 1st Nov. 1905.—MURRAY. *Lancet*, 11th Nov. 1905.—ROGERS and BEEBE. *Journ. Amer. Med. Assoc.*, 17th Feb. and 1st Sept. 1906.—A number of reports of cases treated with Moebius's serum will be found in the files of the *Münch. med. Wochensch.* of 1905 and onwards.

**Grocco's Sign of Pleural Effusion.**—**THE PARA-VERTEBRAL TRIANGLE OF DULNESS.**—In March 1902 Grocco of Florence described as a new sign of pleural effusion a triangular area of dulness



on the sound side of the chest. It is bounded below by the base of the lung, internally by the vertebral spines, and externally by the hypotenuse of this right-angled triangle. Since Grocco made known his discovery, a number of observers have corroborated it, and most clinicians appear to ascribe considerable diagnostic significance to the presence of this triangular dull area. Thayer and Fabyan regard it as a constant and characteristic sign of fluid, and an important addition to our means of diagnosis. They were able to demonstrate its presence in thirty out of thirty-two cases. The breath-sounds over the dull area are faint; there may be ægophony. Ewart lays considerable stress on the fact that when the patient lies on the affected side the triangle of dullness disappears, and returns again when the erect posture is assumed. The triangle is usually larger on the left side—that is, in the case of right-sided effusions—than on the right. The most probable explanation of the phenomena is that offered by Baduel and Siciliano, viz. that the fluid lying against and pressing anteriorly over the bodies of the vertebræ acts as a mute in suppressing the sonorous vibrations of the spine. This deadening of the resonance is naturally appreciable for a certain distance beyond the median line over the area occupied by the transverse processes and the first part of the ribs. It is more marked and extends over a wider area at the base, where the fluid, collecting in the sinus of the pleura, comes into wider contact with the vertebræ and pushes farther around towards the affected side. The displacement of the contents of the mediastinum—aorta, azygos vein, œsophagus, and heart—may play a part, especially in effusion on the right side of the chest, in producing this dullness as well as in bringing about a certain degree of compression of the lung on the opposite side.

REFERENCES.—FABYAN and THAYER. *Amer. Journ. Med. Sci.*, Jan. 1907. EWART. *Lancet*, ii. p. 216, 1905.—BADUEL and SICILIANO. *Riv. crit. di clin. med.*, vi. p. 411, 1905.

**Hæmochromatosis with Diabetes.**—BRONZED DIABETES.—Hæmochromatosis is a rare disease. Up to 1906 only 35 cases had been reported. Fitcher gives as the three cardinal symptoms manifested in the most advanced stages:—1. Pigmentation of the viscera and usually also of the skin. 2. Cirrhosis of the liver, almost invariably of the hypertrophic type and accompanied by striking pigmentation of the organ. 3. Diabetes mellitus, which dominates the clinical picture in the latest stage of the disease. It is due to the final development of a pigmentary cirrhosis of the pancreas, thus interfering with its glycolytic function.

Bronzed diabetes was originally described by Hanot and Chauffard in 1882, and the majority of French clinicians look on the diabetes as primary: the diabetic alteration of the blood causes a destruction of the red cells, with deposition of blood pigment in the skin and viscera. In 1899 v. Recklinghausen described a general pigmentation of the viscera under the name hæmochromatosis. The tissues contained two varieties of pigment: hæmosiderin, which contains iron, and is found in the glands, liver, pancreas, and skin; and hæmofuscin, which is iron-free, and is found in some of the other viscera. The deposit of hæmosiderin in the cells of the liver and pancreas leads to cirrhosis, and when the islands of Langerhans are seriously involved, to diabetes. The ultimate cause of hæmochromatosis is unknown. It may be due to a toxic hæmolysis or to a disturbance of iron metabolism leading to



retention in the system. It is also a disputed point whether the cirrhosis is due to the deposit of hæmosiderin or to the action of the hypothetical toxic agent which causes hæmolysis.

Clinically, the disease seems generally to be recognised when diabetes has developed. Fitcher describes the appearance of his second case thus: "One was immediately struck by the remarkable pigmentation of the skin. This was most marked over the face, neck, and hands, where the skin had a very dark brown colour. The skin of the whole body was much more pigmented than normal, and there was intensification of the colour in the axillæ. . . . There was no pigmentation of the sclerotics, nor of the buccal mucous membrane." A portion of skin removed showed the presence of hæmosiderin in the sweat glands.

REFERENCES.—OPIE. *Trans. Assoc. Amer. Physn.*, p. 253, 1899.—FITCHER. *Ibid.*, p. 278, 1906. Both these papers have bibliographies.

**Hæmoglobinuria, Paroxysmal.**—Some interesting light has been thrown by Eason on the pathology of this disease, and his work suggests a possible line of treatment. He found, in the first place, that the blister serum of a hæmoglobinuric patient, taken in the intervals between the paroxysms, partially dissolved normal blood corpuscles *in vitro*, interfered with the formation of rouleaux, and lessened the amount of fibrin deposited on standing. Serum obtained during a paroxysm lysed both normal corpuscles, and those of the patient himself; the latter were more markedly affected than the former. The amount of hæmolysis produced was greatly influenced by temperature; it did not occur at 37° C., at room temperature it was definite, and at 1° C. it was extreme. Serum which was heated to 56° C. for half an hour lost its power of producing hæmolysis; in this respect it is comparable to an ordinary hæmolytic serum (see IMMUNITY, p. 229), its activity depending, presumably, on its containing a thermostable amboceptor and a thermolabile complement. Shortly after Eason's work was accomplished Donath and Landsteiner recorded some quite independent experiments, which confirmed his observations, and showed, in addition, that a low temperature was essential for the union of amboceptor and red blood corpuscles. Eason's next series of experiments showed that hæmoglobinuric serum lysed corpuscles when it was allowed to act on them first at a low temperature, then at body temperature. During the period of low temperature the amboceptor unites to the corpuscles, but the complement cannot link itself to the amboceptor; in order that it may do so, a higher temperature is needed. As in the case of ordinary hæmolytic serums, inactivated hæmoglobinuric serum may be activated by the addition of fresh normal serum containing complement. According to these observations the paroxysmal hæmoglobinuria is due to the existence in the blood of a potential toxin, consisting of hæmolytic amboceptor and complement, the potential toxin only becoming active under special conditions of temperature. Atmospheric cold and stasis of the peripheral circulation reduces the temperature of the blood locally sufficiently to permit of the union of amboceptor and corpuscles, and the further union with complement (= hæmolysis) rapidly occurs when the blood returns to the internal organs.

By immunising guinea-pigs (the serum of which does not hæmolyse human blood corpuscles) with the inactivated serum of a hæmoglobinuric patient, Eason obtained an anti-amboceptor serum. The antiserum neutralised (*in vitro*) the lytic action of the original hæmoglobinuric



serum, and also that of the serum of a second hæmoglobinuric patient. The observation shows that the hæmolytic amboceptor of paroxysmal hæmoglobinurias is a specific body, and suggests that it may prove feasible to procure an antitoxin.

LITERATURE.—EASON. *Edin. Med. Journ.*, xix. p. 43, 1906; *Scott. Med. and Surg. Journ.*, May 1906; *Journ. Path. and Bact.*, 1906.—DONATH and LANDSTEINER. *Münch. med. Wochensch.*, 1590, 1904.

**Hay Fever.**—In 1902 Professor W. P. Dunbar, the Director of the State Institute for Hygiene, Hamburg, working at the cause of hay fever, disproved the bacterial theories of the origin of the disease which were then prevalent, and confirmed the correctness of Blackley's much earlier observation, viz. that the paroxysms were excited in susceptible persons by inhaling grass pollen. He showed that pollen collected in such a manner as to ensure its sterility retained the power of causing attacks; that pollen does not act merely as a mechanical irritant; that its effects are due to a toxalbumin. Pollen capable of producing hay-fever has been obtained from 25 kinds of grasses, and from the privet, lily of the valley, rape, thistle, and some other plants. The pollen of roses, limes, and wormwood, which have been accused of producing the disease, is inactive. North American autumnal catarrh is due to the pollen of ragweed and golden rod, two common weeds of that continent; it is also caused by the pollen of asters and chrysanthemums. The toxalbumin was prepared by precipitation with alcohol from a salted-out extract of crushed pollen. It is so active that  $\frac{1}{40000}$  mg. (the amount contained in one or two grams of pollen) may bring on an attack in a susceptible person. It resists heat, requiring a temperature of 150° C. to destroy its properties.

When hay-fever toxin is applied to the conjunctiva, nose, or throat, it produces (in susceptible persons) lachrymation, photophobia, sneezing, irritation of the nose, coryza, cough, dyspnoea, stridor; when rubbed into the skin there is local redness or urticaria; subcutaneous injection may produce a severe attack of hay fever, with asthma, cyanosis, urticaria, and oedema—the last named persisting after the respiratory symptoms have subsided. Normal persons are insusceptible, but Semon points out that in persons who are liable to causeless attacks of sneezing a mild grade of reaction may occur. From this toxin an antitoxin (*pollantin*) can be prepared by actively immunising horses. An antiserum has been obtained strong enough to neutralise 60 times the dose of toxin required to produce marked reaction. It can only be standardised by using hay-fever patients as test-subjects. By injecting this antitoxin passive immunity limited to about 24 hours is obtained. The obvious drawbacks to repeated injection render this method of using it impracticable. Owing to the short duration of passive immunity active immunisation is desirable, but on account of the unpleasant results of injections of toxin it cannot be employed for this purpose.

Dunbar points out, however, that as the patient during the hay-fever season is constantly exposed to infection, active immunity will be acquired naturally; during this time he advises the use of pollantin as a prophylactic, therefore his method of treatment is a combination of active and passive immunisation. He advises the daily instillation of one drop of liquid pollantin, or a mass of dry pollantin equal to the size of a pin's head, into each conjunctival sac, and into the nose. This should be done in the morning, before the patient is exposed to



infection. If an attack occurs during the day the dose may be repeated. It is of importance during the treatment that the patient should do his utmost to ward off attacks, by avoiding unnecessary exposure to pollen, and that the treatment should be persisted in, not desisted from, because there has been freedom from hay fever for a few days. He gives the following results of this treatment (1908):—696 cases with excellent results, 381 cases with partial success, 163 cases with no success.

Semon finds that it is impossible to foretell which cases of hay fever will respond to treatment.

LITERATURE.—DUNBAR. *Deutsche med. Wochensch.*, No. ix., 1903; *Berl. klin. Wochensch.*, 15th June, 22nd and 29th July 1903.—Article "Hay Fever," OSLER and M'CRAE'S *System of Medicine*, vol. iii., London, 1908.—SEMON. *Brit. Med. Journ.*, 28th March, 18th April, 18th July, 1903.

## Heart, Diseases of.

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IN no department of medicine has there been greater advance in recent years than in the study of diseases of the circulation. Progress has come from work along two main lines, viz. investigations into the anatomy and physiology of the heart, and the application to clinical work of new methods, particularly in the direction of obtaining graphic records of the movements of the several chambers of the heart.

*Graphic Methods.*—For clinical purposes, Dr. James Mackenzie's clinical polygraph is one of the simplest instruments. Two forms are in use:—1. A Dudgeon's sphygmograph with an additional writing lever actuated by a tambour, which is connected by a rubber tube to a hollow metallic cup or receiver  $1\frac{1}{2}$  ins. in diameter and  $\frac{1}{2}$ -an-inch deep. This receiver is applied over the jugular vein when a record of the venous pulse is desired. For recording the liver pulsations a larger receiver is employed. A time marker may be attached to the sphygmograph. With this instrument simultaneous tracings of the venous and radial pulses, timed in fifths of a second, can be secured on an ordinary smoked paper. 2. The ink polygraph is a more elaborate instrument, and is used when tracings have to be taken over a longer period of time than a sphygmograph allows of. In the ink polygraph the writing points are ink cisterns with pens attached, fixed to the levers of two tambours; the record is made on a continuous roll of paper. One tambour is connected with a receiver for the venous or liver pulse; the other is connected with a third tambour, which is adapted to fit on a splint strapped over the wrist so that a spring in the splint rests against the radial artery. When the tambour is slipped into position on the splint it impinges against the spring, so that it conveys the movements of the pulse to the tambour furnished with a pen, and this



records the movements on the roll of paper. The ink polygraph is furnished with a time marker recording fifths of a second, and an arrangement for varying the speed at which the strip of paper travels.

A full account of the use of these instruments will be found in Dr. Mackenzie's *Diseases of the Heart* (London: 1908). He also gives a full description of the characteristics of the various tracings which may be obtained. Here we shall only refer to the radial and venous tracings, as these afford the most generally useful information as to the action of the heart, and the events in the circulation.

The jugular pulse is recorded while the patient lies down, the shoulders being slightly raised on a pillow, and the head turned a little to the right. The hollow receiver of the polygraph is applied to the neck just above the inner end of the right clavicle with sufficient pressure to exclude the outer air. The receiver may need to be moved about to get the best trace.

The normal venous pulse (Fig. 1) shows three main waves:—The *auricular* wave and fall (*a* and *x*), the *carotid* wave (*c*), and the *ventricular* wave (*v*).

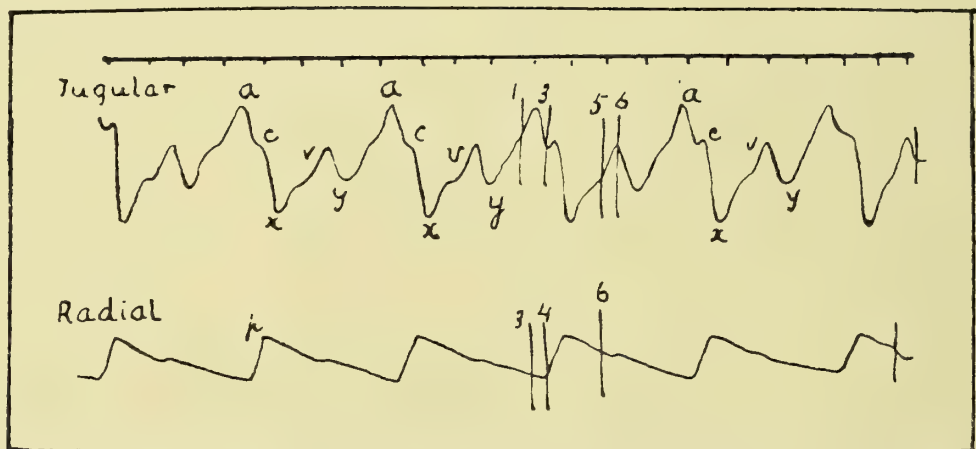


FIG. 1.—Normal venous pulse (after Mackenzie).

The auricular wave is due to the systole of the auricles, and is followed by a fall (*x*) as they relax. After the auricles relax blood is stored up in them during the period of ventricular systole, and this storage of blood causes the lever to rise and produce the wave *v*, which terminates as the auriculo-ventricular valves open and allow the stored-up blood to escape into the ventricles. The termination of the wave *v*, therefore, marks the moment of opening of the tricuspid valve. The carotid wave (*c*) is due to a communicated impact from the carotid artery, and marks the time of ventricular systole. The notch on the wave *v* just before its termination corresponds in time with the closure of the semilunar valves. The interval of time between the auricular and carotid waves is extremely important from the clinician's point of view. It is known as the *a-c* interval, and its normal duration is one-fifth of a second. Prolongation of this period is an evidence of depression of the conductivity of the heart muscle.

The radial trace (Fig. 3) may be divided into two parts, a systolic and a diastolic interval. The systolic period includes the so-called percussion and predicrotic waves (*p* and *r*). According to Mackenzie, the former is instrumental. With the closure of the semilunar valves the pressure falls to the bottom of the aortic notch (*n*) but the fall is interrupted at the beginning of the diastolic period by the dicrotic wave (*d*).



The relationship between the jugular and radial tracings is shown in Figs. 1 and 2. At the commencement of a tracing, before the paper is set in motion, it is customary to allow the levers to record vertical strokes; these afford a fixed point from which measurements can afterwards be taken.

*Analysis of a Tracing.*—When the venous pulse consists merely of a series of irregular undulations (Fig. 2) it is often impossible by simple inspection to localise the various events occurring in it. In such a case the radial tracing is used as a guide. Make a perpendicular stroke at the beginning of a radial pulse, and then a second, one-tenth of a second

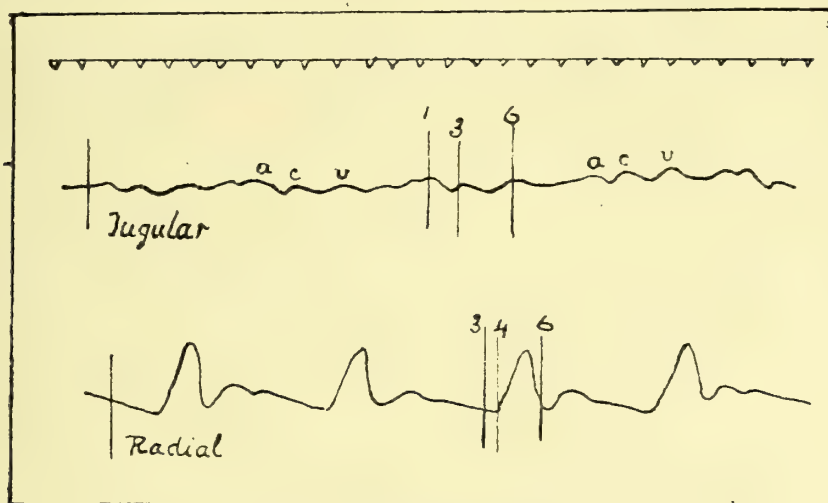


FIG. 2. (After Mackenzie.)

in front of it (4 and 3, Fig. 2). Stroke 3 indicates the time of the carotid pulse. With a pair of compasses mark off the distance from the beginning of the tracing to 3, and measure a similar distance in the venous pulse: a perpendicular at this point will cut the carotid wave. The auricular wave is one-fifth of a second before this (1, Fig. 2). The aortic notch corresponds in time with the undulations on the ventricular wave, just before the termination of the latter, so that a perpendicular through it may also be used as a guide (6, Fig. 2).

*Ventricular Form of Venous Pulse* (Fig. 3).—In this form of pulse



FIG. 3.—Ventricular venous pulse. (After Mackenzie.)

tracing the auricular wave has disappeared, and we now find a large wave synchronous with systole, and a fall synchronous with diastole. Mackenzie looks on this as evidence that the rhythm of the heart is originating at some place other than the mouths of the veins. The rhythm of the heart in which a ventricular venous pulse is obtained is called the "nodal rhythm," and its onset is characterised by (a) a change in the venous pulse from the auricular to the ventricular



type, (b) disappearance of all other evidences of auricular systole, *e.g.* the cessation of a previously existing presystolic bruit, and (c) continued irregularity.

*Electro-Cardiograms.*—The galvanometer has been applied to the study of the movements of the heart by G. A. Gibson and Einthoven, whose independent investigations were carried on, and published, almost simultaneously. Gibson employed Lippmann's capillary electrometer, connecting the acid with the basal region of the præcordia, and the mercury with the apical. In the case examined a condition of heart-block was present, there being three or four auricular systoles to each ventricular systole. The usual diphasic movements of the mercury occurred preceding the apex beat, and between these, smaller oscillations were also detected, evidently due to auricular contractions, since they corresponded with the venous pulsations which had already been found in venous tracings, and with the movements of the auricles seen on the fluorescent screen.

Einthoven's work was more elaborate; he employed a string galvanometer, and recorded its movements on a travelling photographic plate, on which, too, ordinates and abscissæ, representing electric potential and fractions of a second respectively, were also represented. He thus obtained tracings which he called electro-cardiograms, or, when the galvanometer was at a distance from the patient (in the physiological laboratory) and connected with him by a long stretch of wire, "tele-electro-cardiograms." The tracings obtained differ from those got by other means, and for a full account of these the original must be referred to. Briefly, they show five oscillations, of which the first is auricular, the remainder being due to contractions of the ventricles. The curves vary according to the state of the ventricles: thus in hypertrophy of the right ventricle the upward wave is exaggerated; in hypertrophy of the left ventricle, the downward wave is increased. Extra-systoles yield a typical curve. In heart-block the dissociation of auricular and ventricular movements is well brought out. The *a-v* interval in electro-cardiograms is about  $\cdot 175$  sec.

*Ortho-Diagraphy of the Heart.*—The difficulty and uncertainty of exactly determining the size of the heart by percussion is well known. In ordinary skiagrams, and in using the fluorescent screen, the angle at which the rays are projected renders it impossible to record or observe the dimensions of the organ accurately, but by an apparatus known as the ortho-diagraph, it is claimed that an absolutely faithful outline of the heart can be traced. As a special and rather cumbrous appliance is required it is sufficient to describe the principle underlying the ortho-diagraph.

In the ordinary use of X-rays a magnified and distorted image of the heart is projected on the plate or screen. If, however, instead of using the divergent rays from the tube, only one ray, namely, that which is perpendicular to the plane of projection, is used, and if means be provided to conduct this ray round the object (the ray always being kept perpendicular) it is apparent that a true, non-magnified, shadow will be cast. This end is attained as follows:—A fluorescent screen and an X-ray tube are fixed to two parallel metal arms rigidly united to one another. The distance between the arms is such that the thorax can be interposed. The fluorescent screen is perpendicular to the central ray of the tube, and projecting through the screen is a pencil so adjusted as to lie accurately in the axis of the central ray. The whole arrange-



ment is counterpoised on a framework, and is readily movable in all directions. The patient is seated between the tube and screen, on which the shadow of the heart is thrown. The outline of the shadow is now traced on the thorax or on a sheet of paper with the pencil, and as in doing this the observer only utilises the central ray which falls on the point of the pencil, and which moves with the movements of the latter, a true outline of the heart is obtained. The ortho-diagraph was devised by Professor Moritz, and Levy-Dorn's pattern is that generally employed.

Freund states that in ortho-diagrams the heart of an individual remains of constant size under different conditions of rest and exercise. It enlarges under the influence of diphtheria toxin. Dilated hearts are not reduced by baths, but may become normal under the action of digitalis.

LITERATURE.—GRAPHIC METHODS.—JAS. MACKENZIE. *The Diseases of the Heart* (London), 1908.—“The Ink Polygraph,” *Brit. Med. Journ.*, i. p. 1411, 1908.—LEWIS. “The Normal Venous Pulse,” *Brit. Med. Journ.*, ii. p. 1482, 1908. ELECTRO-CARDIOGRAMS.—G. A. GIBSON. *Brit. Med. Journ.*, 7th July 1906.—EINTHOVEN. *Arch. neerl. d. sc. exactis*, ser. 2, tome xi. (Haarlem), 1906—KRAUS and NICOLAI. *Berl. klin. Wochensch.*, 24th June and 1st July 1907. ORTHO-DIAGRAPHY.—FRANZE. *Edin. Med. Journ.*, March 1906.—FREUND. *Wien. klin.-ther. Wochensch.*, 22nd July 1906.

RECENT ANATOMICAL AND PHYSIOLOGICAL WORK.—Of the two opposing theories of the cause of the beat of the heart—the myogenic and the neurogenic—the former is that which is most widely held at present. According to the myogenic theory, the contractions of the heart are automatic, and do not depend on nervous stimuli. During the past four or five years, however, the neurogenic theory has received renewed support, and at present the question as to which is correct remains an open one. The subject is a complicated one, and would require a lengthy discussion to do it justice. For admirable summaries of the arguments for and against, the oration to the Medical Society of London by G. A. Gibson, who inclines to the neurogenic hypothesis (*Edin. Med. Journ.*, July 1907), and an article by Gossage on the “Automatic Rhythm of the Heart” (*Brit. Med. Journ.*, vol. ii. p. 1818, 1907) should be referred to.

Much of our present knowledge of the action of the heart is based on Gaskell's work, which demonstrates that heart muscle possesses the five-fold function of (1) *generating stimuli* to contraction; (2) receiving such stimuli—*excitability*; (3) conveying such stimuli from one fibre to another—*conductivity*; (4) contracting—*contractility*; and (5) maintaining a certain degree of tonic contraction, even where active movement has ceased—*tonicity*.

*Conductivity*.—The nature of the conducting system of fibres has been elucidated by the labours of Stanley Kent and His (jr.), Gaskell, Keith and Flack, Tawara, Erlanger, and others. The conducting fibres consist of the remains of the primitive cardiac tube, and have the power both of originating and conducting impulses to contraction. The auriculo-ventricular bundle—the bridge which conveys impulses from the auricles to the ventricles—was described in 1893 by His and Kent, and its structure and ramifications were carefully worked out by Tawara, whose observations were published in 1906. Keith and Flack discovered a remnant of the sinus venosus (the “sino-auricular node”) near the mouth of the superior vena cava, and this probably is the point from



which the auricular contractions originate. In structure it resembles the auriculo-ventricular bundle; it contains nerve fibrils. Lower down the auriculo-ventricular bundle begins in the auricle in front of the coronary vein and passes forwards on the right side of the interauricular septum to a nodal point ("the node") above the attachment of the mesial flap of the tricuspid valve. From this nodal point the fibres run down in two main bundles, one to each ventricle, which subdivide to form a sub-endothelial network and trabeculæ, and end in the papillary muscles. They are insulated from the rest of the heart by a connective tissue layer. The left main trunk can often be seen in the hearts of elderly persons as a whitish band, measuring about a quarter of an inch in breadth, below the pars membranaceæ septi. The fibres of the bundle and its branches differ histologically from the rest of the heart muscle in showing a less development of sarcoplasm and a more reticular arrangement (Purkinje's fibres). They ultimately lose their connective tissue sheath, and become directly continuous with the heart muscle. The auriculo-ventricular bundle is accompanied by nerve fibrils and a special branch of the coronary artery.

The wave of contraction normally passes from the auricles to the ventricles by way of the auriculo-ventricular bundle. It has been ascertained by experiment upon animals that the time required for the transmission of an impulse from auricles to ventricles along the *a-v* bundle is one-fifth of a second. The impulse can be checked more or less completely by compressing the bundle more or less forcibly. When this is done, an interesting series of phenomena follows. Slight pressure causes a progressive lengthening of the intervals between the contractions of the auricles and those of the ventricles (the auriculo-ventricular period), until eventually the ventricles fail to respond to one of the exciting waves. In the next cardiac cycle, owing to the fact that the longer period of rest has increased the excitability of the ventricles, the auriculo-ventricular period is unusually brief, lengthening out again as before in the succeeding cardiac cycles. As the compression of the *a-v* bundle is increased, the omission of ventricular beats occurs more frequently; thus at first there may be failure on the part of the ventricle to respond to every eighth auricular systole (8:1 rhythm), while with further compression we get a series of 7:1, 6:1, . . . . 2:1 rhythms, in the last of which only every alternate auricular contraction is followed by a ventricular contraction. On still further compressing the bundle, only every third or fourth auricular wave stimulates the ventricles to contract—in other words, rhythms of 1 in 3, 1 in 4, . . . . develop. These stages of partial block are explained by the progressively increasing irritability of the resting ventricular muscle, eventually reaching such a pitch that a mere fraction of the normal stimulus is adequate to provoke a contraction. When a 1-in-3 rhythm is reached, however, complete heart-block is usually established, the ventricles asserting their independent rhythm, and becoming completely dissociated from the auricles. When this condition of heart-block exists, stimulation of the accelerator nerve of the heart increases the rate of both chambers; stimulation of the vagus or its paralysis by atropine, on the other hand, only affects the auricles.

When, instead of compressing the *a-v* bundle gradually, it is suddenly and forcibly clamped so as to produce heart-block, the typical sequence of events is somewhat different. The



ventricles stop, the auricles continue their beat undisturbed, and distend the relaxed ventricles with blood. After a pause lasting up to eighty seconds or more, the ventricles begin to contract again, and take up their own independent rhythm. The pause following sudden tightening up of the clamp may be so long as to induce respiratory convulsions. When partial block is transformed into complete block the same momentary check in the ventricular beat occurs. Partial block can be transformed into complete block by (*a*) stimulating the auricles to beat more rapidly, which results in a less effective though more frequent auricular wave; or (*b*) stimulating the vagus, and thereby inhibiting the auricles altogether.

Erlanger summarises the results of his investigations as follows:—

“1. In the dog, the impulse which normally causes the ventricles to contract is conducted through the auriculo-ventricular bundle of His.

“2. By compression of this bundle all stages of heart-block may be obtained. These include (*a*) an increase of the intersystolic pause; (*b*) an occasional ventricular silence; (*c*) regularly recurring ventricular silences—for example, one silence in ten, nine, eight, seven, six, five, four, three, and two auricular beats; (*d*) a two-to-one rhythm; (*e*) a three-to-one rhythm; (*f*) complete heart-block.

“3. As a rule, the ventricles take on a constant slow rate at the moment complete heart-block is established. Occasionally, usually when the block becomes complete suddenly, there results a marked preliminary slowing of the ventricular rate. The auricular rate does not change.

“4. When the block is complete, stimulation of the vagus nerve has no, or but a minimal, effect upon the rate or force of the ventricular beats, whereas the auricles still react normally.

“5. When the block is complete, stimulation of the accelerator nerve increases the rate both of the auricles and ventricles.

“6. When the block is complete, the rate of ventricular beats may not be materially affected by variations in the general blood-pressure, nor by asphyxia, nor by interference with the coronary circulation.”

The close analogy which exists between experimental heart-block in animals and heart-block as met with in man from disease of the auriculo-ventricular bundle is one of the most striking proofs which has ever been afforded of the value of physiological investigations as applied to practical medicine.

**IRREGULAR ACTION OF THE HEART.**—Mackenzie classifies irregular action of the heart as:—(1) Sinus irregularities; (2) extra-systoles; (3) nodal rhythm; (4) irregularities due to failure of the conducting power of the primitive bundle; (5) depression of the contractility of the ventricles — *pulsus alternans*. Hering's classification is very similar:—(1) *Pulsus irregularis respiratorius*; (2) *pulsus extrasystolicus*; (3) *pulsus irregularis perpetuus*; (4) *pulsus transmissorius*; (5) *pulsus alternans*. In discussing these various forms of irregularity, we shall depart from the order given, and take up, in the first place—

1. *Irregularities due to Failure of the Conducting Power of the Primitive Bundle.*—Under this head comes the very interesting and important condition known as heart-block, with its symptoms, bradycardia and Stokes-Adams disease. The phenomena of heart-block have engaged the study of so many observers, that it is impossible to enumerate all those who have helped to elucidate the subject.



Mention must be made, however, of the work of Mackenzie, G. A. Gibson, Schmoll, Hay, W. T. Ritchie, and A. G. Gibson, whose noteworthy contributions to the clinical aspects of the question have formed a fitting complement to the anatomical and physiological investigations referred to in the preceding paragraph.

Minor degrees of depression of conductivity can only be recognised by taking simultaneous tracings of the jugular and radial pulses. The signs by which it is recognised are (1) prolongation of the *a-c* interval beyond the normal  $\frac{1}{5}$ -sec.; and (2) the occasional dropping out of a radial and carotid wave (Fig. 4).

By the term *heart-block* is meant an interruption in the wave of contraction which normally passes from the auricles to the ventricles. When the wave is blocked, instead of the auricular and ventricular contractions occurring in harmoniously co-ordinated sequence, they become dissociated and independent of one another. The ventricular contractions begin to take place much less frequently than those of the auricles, and, as a result, bradycardia is established. This bradycardia, when, as is often the case, associated with syncopal or epileptiform attacks, is known as Stokes-Adams disease. The Stokes-Adams symptom-complex is now known to be invariably due to heart-block,

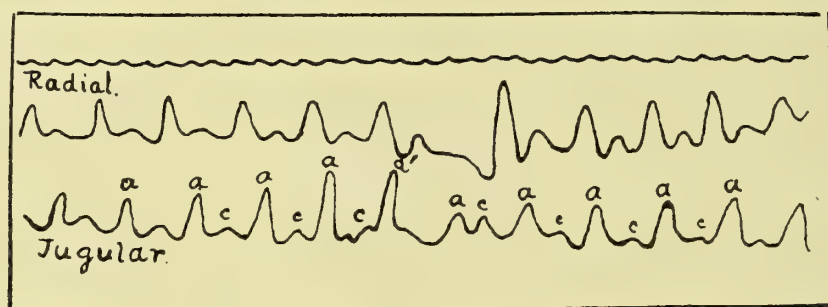


FIG. 4.—Showing gradual lengthening of the *a-c* interval up to *a'*, where the impulse fails to cross to the ventricles and provoke a contraction. Ensuing *a-c* interval shorter, owing to resting ventricle having regained its contractility. (After Mackenzie.)

and to have for its pathological basis a lesion of the conducting fibres between auricle and ventricle.

Clinically, heart-block reveals itself by a persistently infrequent pulse. The infrequency is due to the dropping out of ventricular beats, owing to blocking of impulse descending the *a-v* bundle. The ventricular systole may only drop out at rare intervals, or it may drop out at every 2nd, 3rd, 4th, . . . . beat, giving rhythms of 2:1, 3:1, 4:1, . . . , just as in experimental block referred to above. When the pulse-rate is as low as about 30, the probability is that there is complete dissociation of the ventricular and auricular rhythms, and that each set of chambers is beating independently.

The exact relationship of the auricular and ventricular beats is only to be determined by the aid of tracings. Thus, in Fig. 5 it is seen that only every second auricular wave is followed by a ventricular contraction. Fig. 6 shows the tracing obtained in complete heart-block; the ventricles pursue one rhythm, the auricles another. In some sphygmograms of the radial pulse in heart-block the auricular waves appear as a series of notches in the descending line of the tracing (Mackenzie).

G. A. Gibson points out that on auscultation it is often possible to hear the faint sounds produced by the auricles during the intervals between the ventricular beats. Ritchie has shown that (as in experimental



block) the paralysing effect of atropine on the vagus affects only the auricles; in an observation of this kind the auricular rate rose to 275, while the ventricles continued to beat at 36. The independent rhythm of the two sets of chambers can be demonstrated on the fluorescent screen, or by the electrometer (Gibson). The blood-pressure may be well maintained even when the pulse is very infrequent. In a case of Gibson's, with a rate of 25, the maximum pressure reached 270; in another the maximum was 230, the minimum 75.

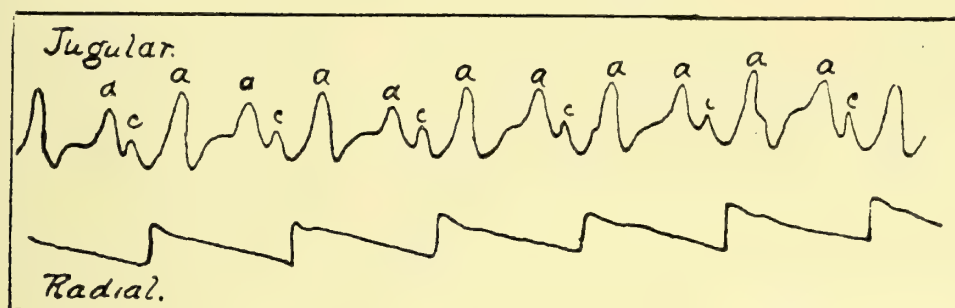


FIG. 5.—The ventricle only responds to every alternate auricular systole. Ventricular rate 48, auricular rate 96. (After Mackenzie.)

The syncopal attacks which go to make up the Stokes-Adams syndrome have already been described (*Encyclopædia Medica*, Vol. IV. p. 444), and need only a brief mention here. They vary greatly in frequency and severity. They may consist merely of a dazed feeling of short duration, with some restlessness or faintness; from this, up to serious or fatal syncope attended by Cheyne-Stokes respiration, all grades occur. They have the common feature, however, of being attended by a cessation of the pulse lasting for several seconds, and

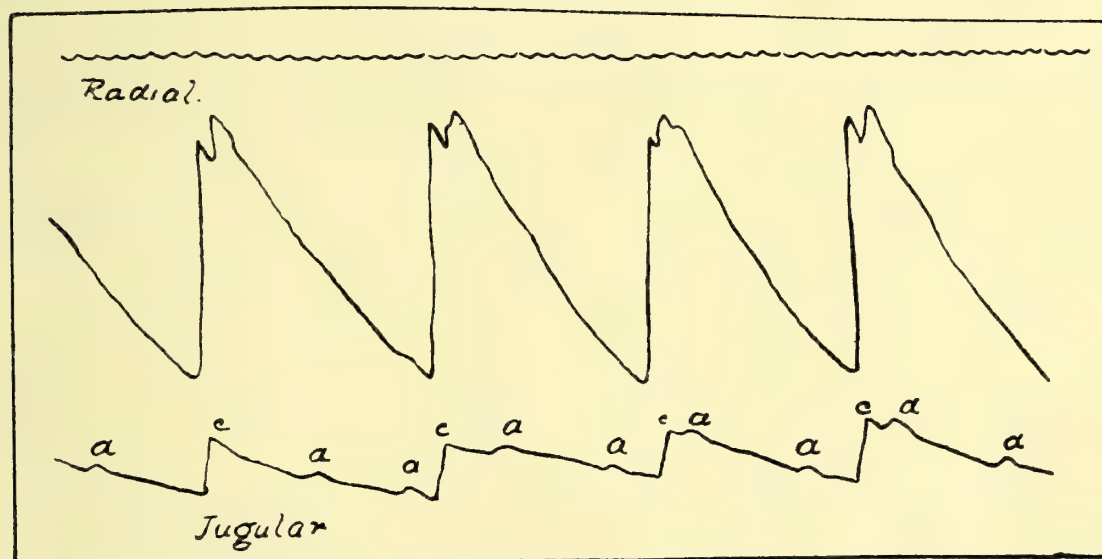


FIG. 6.—Complete heart block, the auricles pursuing one rhythm (a) the ventricle another (after Mackenzie).

when the beat returns it may for some time be less frequent than prior to the seizure. Whether this temporary abrogation of the action of the ventricles is the cause or effect of the seizures was for long in dispute; it is now, however, agreed that in these cases the stoppage of the pulse precedes, and is the cause of, the attack. Syncopal attacks may supervene either in partial or complete block, and also perhaps when the heart is acting normally. As we have seen, experimental complete block, whether sudden or gradual, is attended by a temporary cessation of the ventricular beat, and it is reasonable to suppose that in disease the same thing takes place. When the conductivity of the *a-v* fibres



is lowered by disease, any alteration of the auricular rhythm, such as may occur reflexly by way of the vagus, may be enough to irritate the independent ventricular rhythm and at the same time to cause a syncopal attack. The hypothesis that syncopal attacks are due to the transformation, from whatever cause, of partial into complete block is inadequate to explain their occurrence in cases which already present the phenomena of total block. It may be, as Hay and Schmoll suggest, that in these cases there is some direct interference with the operation of the intra-ventricular stimuli—*i.e.* the independent stimuli which arise in the ventricle itself, and regulate its independent contraction. Syncopal attacks are sometimes heralded by an aura; Jellinek and Cooper suggest that these pre-seizure sensations may be due:—(1) To extra-systoles; (2) to slight short seizures preceding more prolonged ones; (3) to the pumping in of blood into comparatively empty blood-vessels after an extra-systole has failed to open the aortic valves.

The morbid anatomy of heart-block has now been fairly well worked out. In all cases a lesion of the auriculo-ventricular bundle is present. A. G. Gibson quotes the records of thirteen cases, and among the conditions found were fibroid change, gumma, atheroma, arterio-sclerosis, anæmic necrosis, cartilaginous tumour, round-celled sarcoma, and atheroma of the arteries. A remarkable acute case is reported by Jellinek, in which there was (gonorrhœal) septic endocarditis and septic necrosis of the bundle. The essential feature, therefore, is a lesion implicating the auriculo-ventricular fibres.

The prognosis of heart-block with syncopal attacks is uncertain, as the patient may die in a seizure. Patients with bradycardia alone may live for many years. Slight forms of depressed conductivity show that the myocardium is becoming involved. Mackenzie regards these cases as peculiarly susceptible to the action of digitalis, which he believes to lower the conductivity. The drug should therefore be given with caution.

2. *Sinus Irregularity* (Mackenzie), *Respiratory Irregularity* (Hering).—As has been stated, the normal rhythmical stimulus to the contraction of the heart arises in the primitive cardiac tissue at the mouth of the great veins. Under certain circumstances the stimuli may occur at irregular intervals of time, the normal sequence of events in the cardiac cycle being otherwise undisturbed. The characteristic of this form of irregularity (which is of vagus origin) is that the diastolic intervals vary in duration, but on auscultation the intervals between the first and second sound of the heart remain the same, while the individual beats of the pulse are of equal strength. Sinus irregularity is common in children, in young adults after fevers, and when the respiration is slow. It is the form of irregularity which is met with in tuberculous meningitis. Sinus irregularity is not of serious import, and requires no treatment.

3. *Extra-Systoles* (Mackenzie), *Pulsus extrasystolicus* (Hering).—In this form of irregularity there is a premature contraction of the auricle or ventricle in response to a stimulus from some abnormal point in the heart, the fundamental sinus rhythm being otherwise maintained. The irregularity shows itself by a premature beat, followed by an abnormally long pause. The premature beat is feeble; it may be so weak as not to reach the wrist. Hence an extra-systole is recognisable clinically as an “intermission.” The pause which follows an extra-systole may be of



such a duration that the intermission is exactly equal to two pulse periods, in which case it is said to be "compensatory." The pause in *ventricular extra-systole* (*v. infra*) is usually compensatory; in *nodal* or *auricular extra-systole* it is generally shorter (non-compensatory), and in consequence the succeeding pulse beats do not fall into the rhythm we are counting. On auscultation an extra-systole is heard as two short, sharp sounds, or sometimes only a single sound, followed by a long pause.

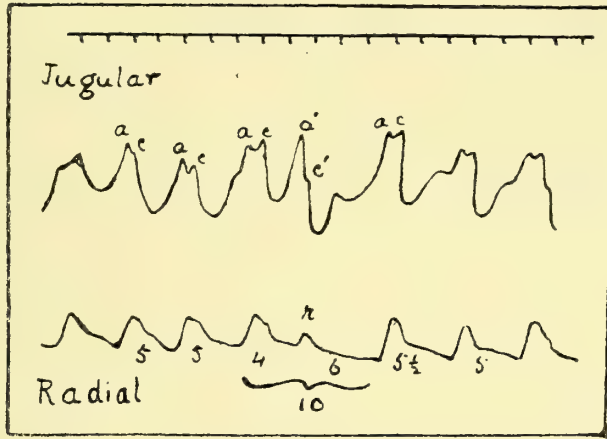


FIG. 7.—Auricular extra-systole at (*a'*). The numbers represent tenths of a second and the irregular period (*r'*) equals two normal periods (Mackenzie).

Extra-systoles may occur quite irregularly, or may be interpolated in regular succession alternating with normal beats, or after every second, third, or fourth beat, etc. (Pulsus bigeminus, etc.). If an extra-systole so feeble as to be imperceptible at the wrist occurs after every beat the pulse at the wrist appears very infrequent, and the condition may be mistaken for bradycardia, from which, however, it can be distinguished by auscultating the heart.

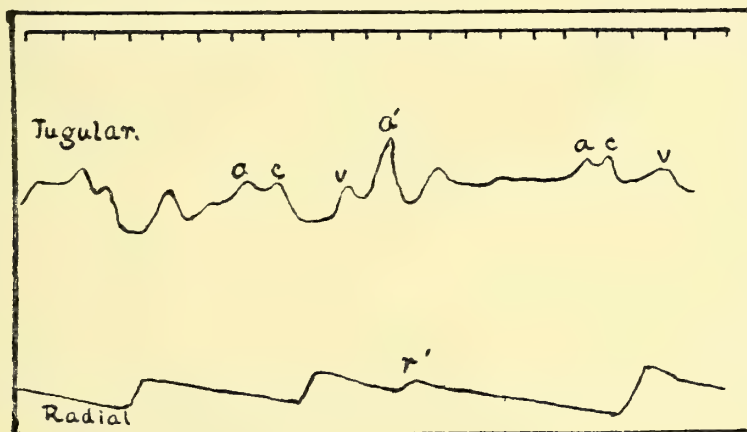


FIG. 8.—In the nodal extra-systole (*a'* and *r'*), the auricular and ventricular systoles are premature and simultaneous (Mackenzie).

An extra-systole may originate from the auricular fibres of the *a-v* bundle, from the node, or from the auriculo-ventricular bundle itself; that is, it may be an auricular, a nodal, or a ventricular extra-systole.

For the differentiation of these forms simultaneous tracings of the jugular and radial pulse are required.

(*a*) *Auricular Extra-Systole*.—In the jugular trace each extra-systolic carotid pulse is preceded by an auricular wave, showing that the extra-systole of the ventricles has been preceded by an extra-systole of the auricles (Fig. 7).



(b) *Nodal Extra-Systole*.—In this form the auricles and ventricles contract both simultaneously and prematurely. This is shown by a premature auricular wave in the venous trace coinciding in time with a premature radial beat. The auricular wave nearly obliterates the carotid wave, which, of course, also almost coincides in time with the radial beat (Fig. 8).

(c) *Ventricular Extra-Systole*.—In the simplest form (Fig. 8) a ventricular systole is interpolated between two normal beats. In the venous trace a corresponding carotid wave is interpolated, but there is no auricular wave, since the extra-systole is not initiated by a contraction of the auricles.

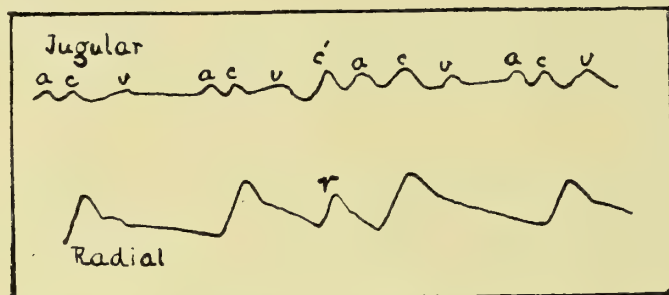


FIG. 9.—Ventricular extra-systole ( $r'$ ) interpolated between two normal beats.  $c'$  is the corresponding carotid wave. (Semi-diagrammatic, modified from Mackenzie.)

A more common form than the above, however, is a ventricular extra-systole, which, instead of being followed by a normal beat, is followed by a long pause. This points to failure of the auricular contraction succeeding the extra-systole (the "post-extra-systolic" contraction) to initiate a contraction of the ventricles. In the venous trace, therefore, the premature ventricular systole is shown by a carotid

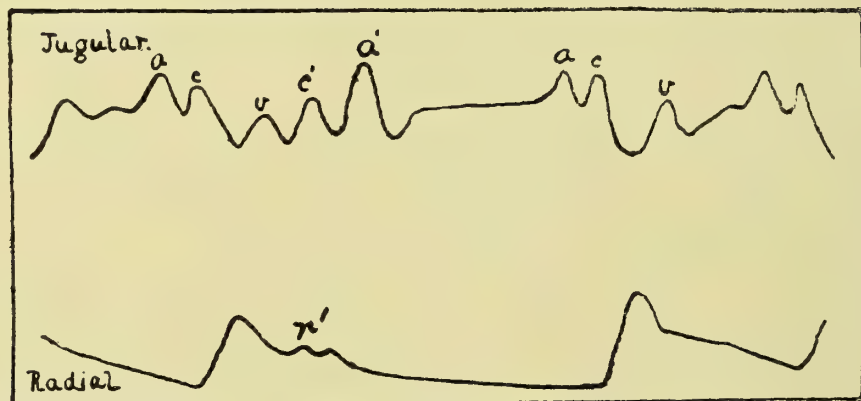


FIG. 10.—A long pause after the extra-systole  $r'$ . The auricular stimulus  $a'$  provokes no ventricular contraction (Mackenzie).

wave. This is succeeded at the normal time by an auricular (post-extra-systolic) wave, which, however, has no carotid wave following it, and no corresponding wave in the radial tracing (Fig. 10).

As we have seen, the auricular wave normally precedes the ventricular contraction. It is therefore obvious that a premature ventricular contraction may coincide in time with the auricular wave. In such a case the tracing resembles that of nodal extra-systole in showing simultaneous auricular and radial waves. The condition is distinguished from nodal extra-systole that in ventricular extra-systole the normal auricular rhythm is maintained, whereas in nodal extra-systole the auricular wave is premature.



Mackenzie regards extra-systoles as due to affection of the *a-v* bundle. He finds that its conductivity is impaired (lengthening of the *a-c* interval), and that, *post mortem*, degenerative changes can be detected in it.

Clinically, extra-systoles are met with in four groups of cases (Wenckebach):—(1) In healthy persons, with no organic disease of the heart; in neurasthenics. (2) In toxic conditions, *e.g.* tea and tobacco poisoning; in infections, *e.g.* pneumonia. The early occurrence of extra-systoles in the course of this disease is a bad sign. (3) In cases of arterio-sclerosis and high blood-pressure. (4) In organic heart disease.

4. *Nodal Rhythm* (Mackenzie), *Pulsus irregularis perpetuus* (Hering).—Under this head are included continued irregularity of the heart (such as occurs in most cases of heart failure) and paroxysmal tachycardia. In nodal rhythm the ventricles and auricles contract simultaneously, and Mackenzie believes that the stimulus to contraction originates at the node of the *a-v* bundle. The heart's action is always irregular and generally rapid. The radial tracing shows this irregularity, while in the venous trace, instead of the normal sequence of auricular and carotid wave, there is a single wave due to auricular contractions coinciding in time with the radial beat (Fig. 3). The nodal rhythm is very embarrassing to the heart; clinically it shows itself by irregularity of the pulse, by disappearance of a pre-existing presystolic murmur, and usually by signs of heart failure. The rhythm may develop suddenly or gradually; it is sometimes sudden in onset and of transient duration (paroxysmal tachycardia). Most cases of nodal rhythm occur in persons who have suffered from rheumatism or cardio-sclerosis; there is evidence of fibroid change in or near the *a-v* bundle (Keith). Nodal rhythm is one of the most serious forms of cardiac arrhythmia; it is due to changes which cannot be cured, and the prognosis depends on how the circulation is carried on under the new conditions, and how the heart responds to treatment.

5. *Irregularity due to Depression of the Contractility of the Ventricle* (Mackenzie), *Pulsus alternans* (Hering).—The four forms of arrhythmia already described depend on abnormalities in the stimuli which lead to contraction, but are not necessarily associated with any failure of contractility. In the long run, however, heart failure means inability of the heart to maintain its power of contraction, and failure of contractility alone may cause irregularity. Normally, after each contraction of the muscle fibres they are so exhausted that a brief period of repose is needed to restore their function; if the renewed stimulus occurs too soon the ensuing contraction is short and feeble. Depression of contractility is shown by pain (angina) and by *pulsus alternans*—large beats followed by small ones. The explanation of this phenomenon is that after the large beat the period of rest is insufficient to rest the muscle, and the next beat is feeble; owing to the short duration of the feeble beat the subsequent period of rest is longer, and so on. The rhythm of the beats in pure *pulsus alternans* is quite regular; on the other hand, when, as is often the case, it is combined with extra-systoles, it becomes extremely irregular. *Pulsus bigeminus* (an extra-systole interpolated after each beat) is distinguished from *pulsus alternans* by the fact that the beats occur in couples, not in regular rhythmical succession.

CLINICAL DIAGNOSIS.—It must not be supposed that for the clinical diagnosis of the various forms of cardiac arrhythmia graphic methods are essential. On the contrary, as Hering points out, the modern



classification has a great advantage over the older one in point of simplicity. Only five possibilities require to be considered, and some of these can at once be eliminated. Even when combination of different forms of irregularity occur, difficulty is not likely to arise, for in most cases the combination proves to be an association of extra-systoles with one of the other four varieties. Certain combinations do not occur, *e.g.* continued irregularity with delayed conduction or pulsus alternans, and delayed conduction with pulsus alternans.

*Extra-Systoles*, the most common form of irregularity, are characterised (in many cases) by the subjective sensation of thumping in the præcordial region, and by the sharp drum-like tone of the sound they produce. When in an otherwise regular pulse a premature beat suddenly occurs, it is an extra-systole. An intermission is most likely to be an extra-systole, and, if accompanied by a "bump" in the præcordial region, is certainly one. It is distinguished from a missed beat from failure of the ventricles to contract by auscultation; in the extra-systole the characteristic sharp sound is usually audible, but in a true missed beat no sound is produced. This difficulty in differential diagnosis is most likely to occur in cases of bigeminal pulse, when the question may arise, whether or not every third beat is being missed from failure of the ventricle to contract. In true bigeminal pulse, due to extra-systole, every second beat is accompanied by a sharp first sound.

*Respiratory (Sinus) Irregularity* is easily recognised by the fact that only the time intervals, not the force of the beats, vary. The arrhythmia depends on the respiratory movements, and ceases when the patient stops breathing. When the breathing is irregular (as in meningitis) it is less easy to make out the association between the pulse and the respiration. The chief practical point is to decide whether or not respiratory arrhythmia is caused by a cerebral lesion.

*Continuous Irregularity (Nodal Rhythm)* is characterised by its persistence, and by the great variations in the force and time of the pulse beats. The venous pulsations in the neck synchronise with the apex beat. Irregularity of this type diminishes, but does not disappear, under the influence of digitalis.

*Bradycardia* due to lowered conductivity is easily recognised. When the pulse is about 30, there is probably complete dissociation between auricular and ventricular action. More than this cannot be said without the aid afforded by tracings. The differences between an occasional missed beat and the intermissions of extra-systole have been referred to.

Pulsus alternans is not common; it has to be distinguished from continued pulsus bigeminus (*v. supra*). It is not always easy to discern the difference in force between the two beats by the finger. Pulsus alternans becomes more marked when the heart acts quickly, as after exercise; less marked when the heart is slow, as under digitalis.

*Significance of the Various Forms of Arrhythmia.*—The chief practical point is to distinguish the mild forms of irregularity (respiratory arrhythmia and extra-systole) from those which are serious (lowered conductivity, continuous irregularity and pulsus alternans).

Respiratory arrhythmia is never in itself serious; it may signify organic brain disease.

Extra-systole, if due to tea or tobacco, or if associated with subjective sensation of a jog in the region of the heart, is of functional origin. Occurring in cardiac disease, extra-systoles do not add to the



gravity of the condition. Possibly when they develop in the course of pneumonia or acute rheumatism they may point to the myocardium becoming implicated (Mackenzie).

Continued irregularity is always ominous, as it shows that the heart muscle has undergone organic changes. When it sets in suddenly it may gradually embarrass the heart. In heart disease the prognosis depends on how the circulation is maintained (presence or absence of cyanosis, dropsy, etc.) in spite of the nodal rhythm, and on the response to treatment. In pneumonia and other acute infections continuous irregularity is a very bad sign (Mackenzie).

A mild degree of lowered conduction should be accepted as a warning that myocardial changes have begun. It is necessary to use caution in administering digitalis under these circumstances, on account of the effect of the drug in depressing conductivity. Patients suffering from bradycardia may live for many years. When syncopal attacks occur, the prognosis is uncertain, as the patient may die in a seizure.

Pulsus alternans is always a serious sign, especially in cases of arteriosclerosis, and in acute infections (Mackenzie).

LITERATURE.—This is very extensive, and only a few of the papers can be mentioned. Acknowledgment must specially be made of the debt which the compiler of this section owes to Dr. MACKENZIE'S *Diseases of the Heart* (Lond.), 1908. A full classified list of references will be found in this book.

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## Heredity.

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IN two directions advances have been made during the past five or six years in our knowledge of the phenomena of heredity: Mendel's law regarding the inbreeding of hybrids has been brought to the light and applied in various relations, and Galton and Karl Pearson have attempted to solve the problems of heredity from the statistical side.

MENDEL'S LAW.—There is no more extraordinary page in the annals of science than that on which is written the story of Mendel's discovery. In a paper "which is a model of lucidity and expository skill" (Bateson), Gregor Johann Mendel, Abbot of Brunn, gave to the world in 1866 the results of experiments in hybridisation which he had been patiently



conducting for eight years; the plant experimented upon was *Pisum sativum*, the edible pea, and the work was done in the large garden of the cloister at Brunn, of which Mendel was Prälat or Abbot; he published another paper in 1869 on Hieracium-Hybrids; and he died, early in 1884, without having seen the slightest notice taken of his work, but with the firm belief that his time would come. The scientific world, however, had to wait till the dawn of the twentieth century before it heard of Mendel's Law, for it was not till 1900 that De Vries, Correns, and Tschermak, independently of each other, rediscovered it and confirmed it by experiment; since then, W. Bateson has done much to make it known in Great Britain, and has experimented afresh along similar lines. So Mendel's article was exhumed from the *Proceedings of the Natural History Society of Brunn*, where it had lain buried for thirty-four years.

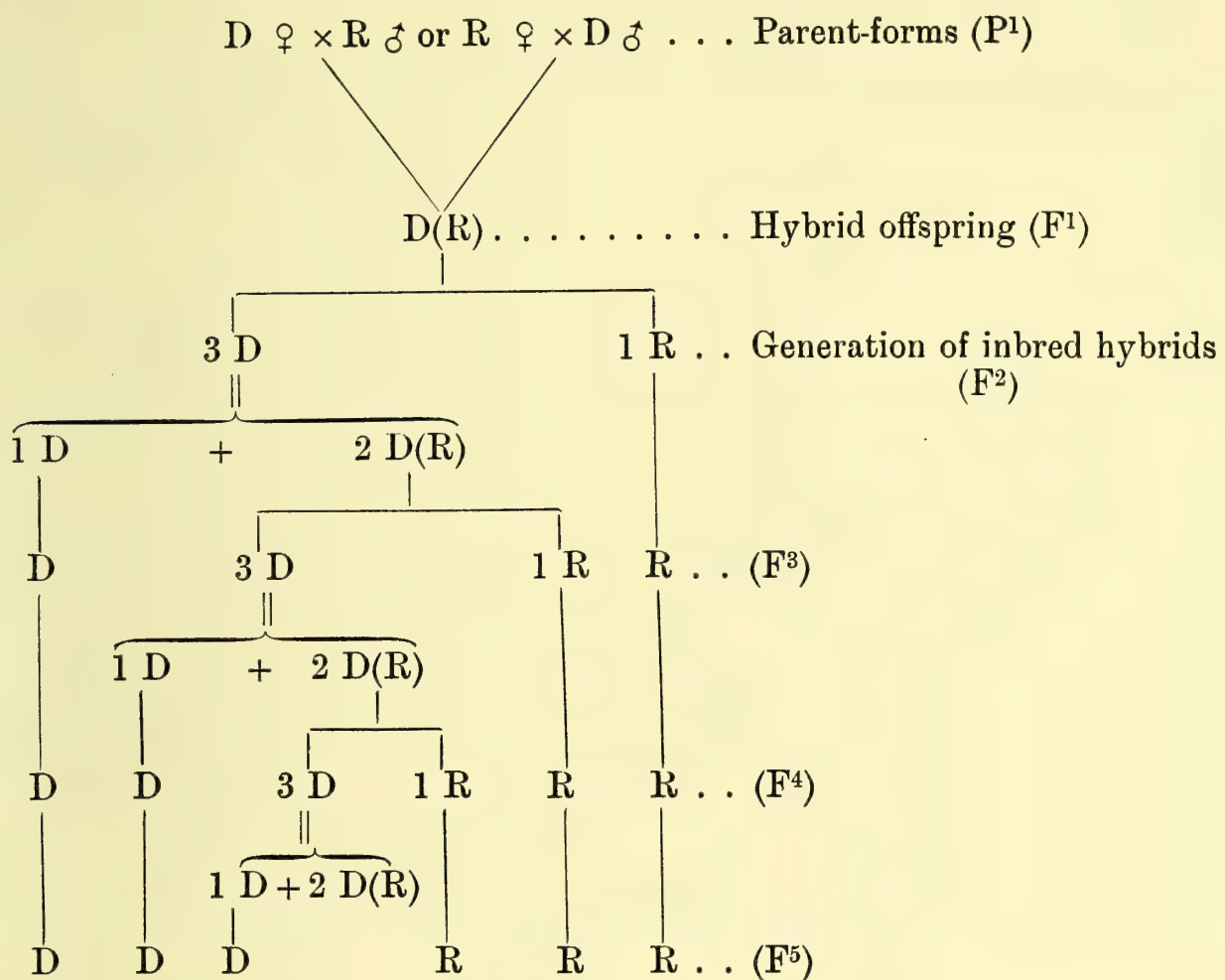
The Law referred to is one of inheritance in hybrid varieties, a fact and a limitation which is at the present time in some danger of being lost sight of. "It must be clearly noted," writes Prof. J. Arthur Thomson (*Heredity*, p. 381, 1908) "that Mendelian phenomena are not known except in certain cases of hybridisation . . . the danger is of trying to universalise the Mendelian formula, and some of the attempts that have been made to give a Mendelian interpretation to discrepant facts seem to us very far-fetched." With this caution in mind, we must approach the subject of Mendel's Law.

Taking the common pea, which, in its sub-species or varieties, possesses constant differentiating characters, allows easy artificial pollination, has fertile hybrids, and can be readily protected from foreign pollen, Mendel crossed two varieties and then inbred (self-fertilised) the resulting hybrids; in this way he discovered the laws of dominance and segregation. Thus, taking the length of the stem (tall or dwarfish) as the differentiating characters, he crossed the tall and the short varieties; the result was that all the hybrid offspring were tall; tallness, therefore, was regarded as the *dominant* character, for it prevailed, whilst shortness, because it was the suppressed or apparently suppressed character, was called *recessive*. So, T crossed with S gave T, or D  $\times$  R gave D. Self-fertilisation of the hybrid plants was now permitted, with the result that the next generation were not all alike tall, but showed the two original forms in the proportion of three tall to one short, or three dominants to one recessive (in percentages, 75 to 25). This is the law of *segregation* or splitting, viz. that the cross-bred plants when self-fertilised produce plants with the dominant character in the proportion of three to one with the recessive. If, now, the short-stemmed plants (recessives) were self-fertilised they bred true, that is to say, they never again produced tall ones, but only dwarfs. Further, if the tall-stemmed plants (dominants) were allowed to be self-fertilised, they produced one-third dominants, which thereafter always bred true, *i.e.* produced nothing but tall (dominant) plants; the other two-thirds, on the contrary, when self-fertilised gave rise to a mixture of dominants (talls) and recessives (shorts) in the proportion of 3:1 or 75 per cent. to 25 per cent. Mr. R. C. Punnett (*Mendelism*, 1905) puts the results concisely thus: "Wherever there occurs a pair of differentiating characters, of which one is dominant to the other, three possibilities exist—there are recessives which always breed true to the recessive character; there are dominants which breed true to the dominant character, and are therefore pure; and thirdly, there are



dominants which may be called impure, and which, on self-fertilisation (or inbreeding, where the sexes are separate), give both dominant and recessive forms in the fixed proportion of three of the former to one of the latter." The characters (in the case referred to above, tallness and shortness) which thus segregate or dissociate from each other are described as *allelomorphic*.

Professor J. Arthur Thomson (*Heredity*, p. 340, 1908) gives a useful schematic representation of these phenomena, which is reproduced below. D stands for the dominant character and R for the recessive (whatever these may be), and D(R) means that the dominant character is present whilst the recessive is *apparently* absent.



Mendel and those who after a lapse of forty years have rediscovered this law of inheritance in hybrid varieties advance the following theory to explain the phenomena which have been referred to above. It is assumed that the hybrid offspring (F<sup>1</sup>) contain material representatives of the unit characters (*e.g.* tallness and shortness), although they themselves show only one (*viz.* tallness), the parent with the dominant character having been prepotent. But the first generation of inbred hybrids (F<sup>2</sup>) show both tall and dwarf plants. To explain this, it is argued that the germ cells of the hybrid offspring (F<sup>1</sup>) divide themselves into two groups (two kinds of egg-cells and two kinds of pollen-grains), one group with the potential quality of tallness and the other with that of shortness or dwarfness; the two groups are supposed to be practically of equal size, and therefore, when self-fertilisation takes place, the chances of an egg-cell being impregnated by a pollen-grain with tallness, or by a pollen-grain with shortness, are equal. If, now, there are eight egg-cells, four with the potential quality of tallness and four with that of shortness, and if there are eight pollen cells similarly arranged; then, in



fertilisation, two egg-cells with tallness will be fertilised by two pollen-grains with tallness, two egg-cells with shortness will be fertilised by two pollen-grains with shortness, and the remaining four egg-cells (two with tallness and two with shortness) will be fertilised by the remaining four pollen-grains (two with shortness and two with tallness); the result will be two fertilised egg-cells with tallness, two with shortness, and four with both tallness and shortness. But since tallness is dominant, the last-named four will show it alone, the quality of shortness being latent in them; in other words, there will be six with tallness and two with shortness, or three dominants to one recessive,  $2 D + 4 D(R) + 2 R$ . This explanation is both simple and satisfactory, and it is known as the theory of gametic segregation. It is clear, therefore, why there are "pure" gametes and "impure" gametes: to the former group belong the  $2 D$  and  $2 R$ , whilst to the latter belong the  $4 D(R)$ ; the former always breed true among themselves, whilst the latter split up again in the proportion of  $3 D$  to  $1 R$ , shortness (the recessive unit character) reappearing over and over again in succeeding generations, and always in the proportion of one to three.

It is unnecessary, in a short article such as this, to enter into the elaborations of the Mendelian theory; they are most interesting, but very complicated, and are in danger of being made too subtle. It is only necessary to study the results of breeding pure types with *impure* dominants in order to demonstrate this complexity and bring into play this subtlety. Suffice it to say that Mendel's Law has received confirmation in several plants other than the common pea, in maize, for instance, in wheat and barley, in stocks, in nettles, and in *mirabilis jalapa*; and it has been extended to some animals, *e.g.* mice, rabbits, snails, poultry, and cattle. In mice, for instance, the coloured coat would appear to be a dominant, and the albino a recessive character. These discoveries open up a wide and most attractive field for experimentation and speculation, and suggest that there may be characters in the human subject which will be found susceptible to arrangement as dominants and recessives. It must be admitted, however, that no secure evidence of Mendelian phenomena in man have yet been noted: for the white negro is a *rara avis*, and he ought to be common if Mendelism be true of the human subject; and the suggestion that the presence of congenital cataract may be a dominant character seems to be highly paradoxical. It will take many years, however, before the far-reaching consequences of Mendel's Law have been investigated, and it is more than likely that results of considerable practical importance may flow from its application in various novel directions (*e.g.* in the elucidation of the differentiation of sex, as tentatively worked out by Berry Hart).

LITERATURE.—The already copious literature of this subject will be found in BATESON'S *Mendel's Principles of Heredity* (1909), and in J. ARTHUR THOMSON'S *Heredity* (1908). The following articles may be consulted by the medical reader:—BATESON. *Brit. Med. Journ.*, ii. for 1906, pp. 61, 106; i. for 1908, pp. 1132, 1195, 1252.—MUDGE. *Brit. Med. Journ.*, ii. for 1908, p. 523.—BERRY HART. *Trans. Edin. Obstet. Soc.*, vol. for 1908-9; *Proc. Roy. Soc. Edin.*, xxix. 607, 1909.

GALTON AND PEARSON'S WORK.—The law of Mendel brings mathematics into the sphere of biology and heredity; but in the work of Sir Francis Galton and Karl Pearson mathematics dominates biology to such an extent as to cause the latter to pass almost entirely out of sight. If the reader will consult Pearson's *Grammar of Science* (1900),



or take into his hand any part of the journal *Biometrika*, he will be persuaded that the above statement is no great exaggeration. Sir Francis Galton's Law of Filial Regression or Correlation, that tendency towards mediocrity, towards sustaining the same average level from generation to generation, is expressible as a formula; whilst the law of Ancestral Inheritance can hardly be expressed in any other way. The latter law, as stated by Galton, is as follows: "The two parents between them contribute *on the average* one half of each inherited faculty, each of them contributing one quarter of it. The four grandparents contribute between them one quarter, or each of them one-sixteenth; and so on, the sum of the series  $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots$  being equal to 1, as it should be. It is a property of this infinite series that each term is equal to the sum of all those that follow: thus  $\frac{1}{2} = \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots$ ,  $\frac{1}{4} = \frac{1}{8} + \frac{1}{16} + \dots$ , and so on." Pearson states the law more completely in mathematical form when he says, "Each parent contributes on an average one quarter or  $(.5)^2$ , each grandparent one-sixteenth or  $(.5)^4$ , and so on; the occupier of each ancestral place in the  $n$ th degree, whatever be the value of  $n$ , contributes  $(.5)^{2n}$  of the heritage." The medical man who may wish to study these matters without entering far into problems of algebra and mathematics will find a clear exposition in Thomson's *Heredity* (pp. 309-335), already quoted from. It may be noted, however, that Mendel's law and that of Ancestral Inheritance do not harmonise. At the same time it is not wise to make too much of this or to argue from it that all Galton's and Pearson's results must go to the wall; "for the Mendelian formulæ," as Professor Thomson says, "apply to the progeny of known crosses or hybrids, while Galtonian formulæ apply to intra-racial heredity."

**Herpes Zoster.**—Whilst Herpes Zoster, where the lesion is in the ganglia on the posterior roots of the spinal nerves, causing a vesicular eruption on the body, neck, or extremities, and in the Gasserian ganglion, causing an eruption on the face in the distribution of the three divisions of the 5th nerve, is a well-recognised condition, a less well-known form is that caused by a lesion in the geniculate ganglion of the 7th nerve. In this case one gets a vesicular eruption on the outer aspect of the auricle, associated with pain in the ear, deafness or noises in the ear. The auditory symptoms are due to the swollen geniculate ganglion, as it lies in the aqueduct of Fallopius, pressing on the adjacent auditory nerve. As there is often considerable swelling of the outer ear, and after the vesicles burst the ear is covered with crusts, the true cause of the condition is apt to be overlooked. This is especially so from the associated auditory symptoms, the inflamed condition of the auricle being put down to a secondary infection from a middle ear discharge.

REFERENCE.—RAMSAY HUNT. *Amer. Journ. Med. Sci.*, Aug. 1908.

**Hormones** (*ὁρμαω*, to arouse, or excite).—This term has recently been used to describe certain internal secretions of the body, particularly in reference to a particular type of mechanism correlating the activities of various organs. The modern view of Hormones is well explained by Starling. "In the normal life of the higher animals, which must be considered as a continuous series of reactions to changes in the environment, ending only with the death of the animal, those reactions which are carried out through the intermediation of the nervous system,



play such a preponderant part that we have almost forgotten the possibility of other means of coadaptation among the different organs of the body. Yet in the lowest organisms, before the appearance of any central nervous system, it is by chemical means that any co-ordination of function is determined, either among the different organisms of a colony, or among the various cells making up a multicellular organism such as the sponge. In this case the mechanism which determines the movement of phagocytic cells towards an irritant, the chase of food, the escape from noxious environment, or the approach of sexual cells has been given the name of chemiotaxis. Since the application of these chemical stimuli depends on their diffusion through the medium bathing the cells, the process is necessarily a very slow one." The need for quick reactions led to the development of a nervous system about which the whole history of the evolution of the higher types centres. But the development of the special nervous system adapted for quick response to changes in the environment "has not abrogated the more slowly and primitive method. . . . Where the necessity does not exist for a specially rapid reaction, as, for instance, in the adaptation of the activities of the digestive glands to the presence of food in the alimentary tract, one might expect to find, as we have found, that the connection between the part of the body receiving the stimulus, and the part of the body which has to react to the stimulus, should be by chemical means." Of these chemical messengers or hormones as they may be termed, we know those which determine the activity of the gastric glands, the pancreas, the liver, and the intestinal glands. The suprarenal bodies manufacture adrenalin which, travelling over the whole body, seems to be a necessary condition for the excitation of any sympathetic nerves. The thyroid in the same way manufactures some substance necessary for the proper growth of the tissues; the foetus appears to secrete into the blood of the mother some substance which excites the growth of the mammary glands. "It is probable that with increasing knowledge the list of these messenger substances will be largely extended, and that, with their isolation, we shall have at our command means of influencing the growth and activity of the majority of the organs of the body. It is worthy of note that these substances do not belong to the group of physiologically active agents of complex and indefinite chemical composition, such as the ferments and toxins, but are in all probability well defined chemical substances, highly unstable in most cases, but capable of analysis, and, in some cases at any rate, of artificial synthesis. They are comparable in many respects to the . . . drugs of our pharmacopœia. The practice of drugging would seem therefore to be, not an unnatural device of man, but the normal method by which a number of the ordinary physiological processes of the organism are carried out."—*Recent Advances in the Physiology of Digestion*, pp. 88-91 (London), 1906. See also DIGESTION, p. 149.

**Hyperchlorhydria.**—The most common of all forms of indigestion—acid dyspepsia—is that which is associated with abnormal acidity of the gastric contents. Hyperchlorhydria, or hypersecretion, has been the subject of many communications during the past five or six years, and there is much diversity of opinion as to its nature. For some, the fault is a secretion of hyperacid gastric juice, and it is stated that the presence of more than .2 per cent. of HCl one hour after



Ewald's test breakfast is evidence of hyperacidity. It appears, however, that in some persons a higher percentage than this may be unaccompanied by symptoms, and that in others symptoms may exist with a lower percentage. According to Bickel's latest researches, the fault is more often quantitative than qualitative, and the percentage of acid secreted remains at a uniform level. The main justification for retaining the term hyperchlorhydria is the definiteness of the symptom-group.

It is most common in youth or middle age, and among the chief causes which predispose to it are mental worry and overwork, especially in persons of a nervous disposition, indiscretions in diet, abuse of alcohol and tobacco; it is also related to gastric ulcer and duodenal ulcer, to chlorosis, and to chronic constipation. The chief symptoms are heartburn, acid eructations, and severe epigastric pain. The pain comes on from two to four hours after a meal, and often radiates to the back; it is relieved by the ingestion of food, especially bland albuminous food, such as milk, and by alkalies. Vomiting is rare; the appetite remains good, chronic constipation is the rule.

In point of diagnosis, the principal matter is to exclude gastric ulcer. It must be remembered that hyperchlorhydria exists as a symptom of ulcer, so that the difficulty may be very great. The pain of gastric ulcer is said to be more directly influenced by the bulk of the food taken; it also begins sooner as a rule. The stools should be examined for "occult bleeding." Looking at the question of diagnosis from another point of view, some deny that hyperchlorhydria is ever an independent disease; thus Cohnheim, for example, classifies cases under the following heads:—(1) Acid gastritis; (2) ulcer and stenosis of the pylorus; (3) chronic constipation; (4) gastric crises of tabes; (5) neurasthenia—and considers that each case should be treated according to its cause.

**TREATMENT OF HYPERCHLORHYDRIA.**—Two different lines of dietetic treatment each have their advocates. In one the carbohydrates are limited; in the other a mixed diet, with abundant carbohydrates, is given. Russell, who limits the amount of carbohydrates, explains the symptoms in the following way:—When the equilibrium between the amount of gastric secretion required to digest a meal and the quantity of food in the stomach is upset, and there is, in consequence, excess of HCl, the result is that the proteid elements of the food are digested with exceptional alacrity and pass out of the stomach, while the carbohydrate elements are retained. The retained unaltered starch keeps up the gastric secretion, while presenting no constituent with which the acid can combine. At this stage, the gastric contents are extremely acid, and contain only a residue of unaltered starch. The perpetual recurrence of this state of matters ultimately leads to catarrh and atonic dilatation. Russell advises the administration of alkalies, the restriction of the diet to the actual requirements, and the limitation or exclusion of unaltered starches, especially bread and potato. In bad cases he gives a purely proteid diet (raw eggs) for a day or two. When the paroxysms are severe, immediate relief is given by withdrawal of the acrid stomach contents.

On the other hand, those who advocate a mixed diet, with liberal carbohydrate, do so on the ground that proteids tend to provoke a more active secretion of gastric juice than do the starches. The following points may be noted:—Pawlow's work has shown that the



extractives of meat are *par excellence* among exciters of gastric secretion (see DIGESTION). Hence soups, beef extracts, beef tea, and underdone beef should be excluded from the food. In the same way, the food should be bland, and should not require much mastication, in order that the stomach may be stimulated neither by the food itself, nor reflexly by the act of chewing. Alcohol and spices are forbidden. The meals should not exceed three in the day, and no food should be taken between meals, unless there is pain, when a little milk may be allowed to fix the free hydrochloric acid. Fat checks the secretion of gastric juice, hence it should enter liberally into the diet; it also checks the tendency to constipation which is so common. Soluble carbohydrates, particularly solutions of sugar, lead to a very scanty production of acid. A dry diet is inadvisable. Among the articles of diet permitted are eggs, butter, boiled meats, steamed fish, milk, the milder forms of cheese, especially cream cheese, oysters, sardines, cream, most vegetables and farinaceous foods, both of which must be well boiled. Starchy food should be taken as early during a meal as possible. Jams, jellies, and creams are allowable.

*Drugs.*—Alkalies are always given. Carbonate of magnesia is best, on account of its laxative action. A teaspoonful should be taken when the discomfort begins. The irritability of the stomach is relieved by bismuth or nitrate of silver. Boas prescribes sodium citrate after meals in place of sodium bicarbonate. Bickel recommends atropin to diminish the gastric secretion. Large doses of olive oil are advocated by Cohnheim. He gives it either in a single dose of 2-3 ozs. by the stomach tube every morning, or in  $\frac{1}{2}$ -oz. doses before each meal.

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**Hypertrichosis.**—Hypertrichosis in females may be successfully cured by X-rays, but the hair requires to be repeatedly brought out by the rays before it ceases to regrow. A reaction from X-rays is to be avoided, as that greatly increases the subsequent atrophic condition of the skin; but at the best, some atrophy of the skin is bound to be produced before the hairs are permanently destroyed. This method of treatment should only be undertaken by an expert.

REFERENCES.—JUTASSY. *Fortsch. a. d. Geb. d. Röntgensk.*, ii. p. 194, 1898-99.—KEINBOCK. *Verhandl. d. deutsche dermat. Gesellsch.* (Breslau), 1901.

## Immunity.

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IN only a few of the diseases due to bacterial invasion is a soluble toxin formed. In most instances we have a rapid proliferation of the



organisms within the body, and their action by the production of intracellular toxins. In the former group of infections, cure may be brought about by a simple neutralisation of the toxin circulating in the blood (as in diphtheria); in the latter series, what is essential is the destruction of the bacteria themselves.

ANTIBACTERIAL ACTION.—This may be considered under three heads:—(1) Bactericidal action, including lysogenic action in general; (2) agglutination; (3) opsonic action.

(1) *Bactericidal and Lysogenic Action*.—Pfeiffer discovered that if an animal was immunised by inoculation with dead cholera bacilli, and if, thereafter, a lethal dose of living bacilli was introduced into the peritoneal cavity, the organisms were killed within a relatively short period. He further showed that on injecting into a normal animal living cholera vibrios along with anti-cholera serum, which had been heated to 58° C., and had, in consequence, lost its bactericidal power *in vitro*, the same destruction of the organisms took place. He inferred that the inactivated anti-cholera serum did not in itself contain the bactericidal element, but that it merely, in some way or other, enabled the tissues of the non-immune animal to cope with the bacteria. The nature of the defensive mechanism was further elucidated by Bordet, who found that, while no bactericidal action occurred in a mixture of heated anti-cholera serum and vibrios, the addition of fresh serum from a non-immune animal caused bacteriolysis, but that if the fresh serum had been previously heated it lost this power. Bordet thus proved that two substances are concerned in bactericidal action—one, in the fresh serum, which is thermolabile, and one, in the immune serum, which is thermostable. The thermolabile body is called the *complement (alexin)*, the thermostable body the *amboceptor, copula, or immune body*. In what follows we shall adhere to the terms complement and amboceptor. The amboceptor is a specific substance—a mixture of fresh serum with inactivated anti-cholera serum being bactericidal to cholera vibrios only.

Bordet also pointed out that the phenomena following the inoculation of one species of animal with the red blood corpuscles of another species present many analogies to the above, and it is on this account, as well as because blood corpuscles form a very convenient means of investigation, that so much work has been done on hæmolytic sera. If an animal A be immunised by repeated inoculation with the corpuscles of another species B, the serum of A acquires the power of dissolving B's corpuscles. The action is specific, or nearly so; that is, the corpuscles of other species are not, as a rule, affected. This hæmolytic serum can be inactivated by heating to 58° C., and can again be activated by adding fresh normal serum, but not by adding normal serum which has been heated. Hæmolytic serum, therefore, contains thermostable amboceptor and thermolabile complement; normal serum contains complement only.

The relations of amboceptor and complement have been still further studied by Ehrlich and Morgenroth. The following experiments illustrate the methods employed in researches of this nature:—A mixture of sheep's corpuscles and inactivated hæmolytic serum was centrifuged, the fluid (A) decanted, and the corpuscles (B) washed:—(1) A+sheep's corpuscles+fresh normal serum=no hæmolysis; therefore the amboceptor originally present in the hæmolytic serum has been removed from it. (2) B+fresh normal serum=hæmolysis; therefore the amboceptor of the inactivated hæmolytic serum has transferred itself



to the corpuscles. Having thus demonstrated that the amboceptor interacts with corpuscles, the next step is to ascertain whether complement does so also. A mixture of fresh goat's serum and sheep's corpuscles was centrifuged, the fluid pipetted off (C), and the corpuscles washed (D):—(3) C+inactivated hæmolytic serum+sheep's corpuscles = hæmolysis; therefore C still contains complement. (4) D+inactivated hæmolytic serum=no hæmolysis; therefore the corpuscles have not attracted complement. There are thus two partners in the work of hæmolysis and bactericidal action—the specific amboceptor present only in the serum of an immunised animal, and the complement present in the serum of both normal and immunised animals.

Is there only one, or are there many, amboceptors concerned in such phenomena. Ehrlich has shown that the latter is the true state of affairs, and that it is possible by immunising animals with cells, both from different organs and from various species, to obtain a great variety of specific cytotoxic sera, each with its own amboceptor. But when we come to ask the same question concerning the complement, we do not get so clear an answer. Ehrlich holds that complements, like amboceptors, are multiple; while Bordet adheres to the view that the complement is single. This and many other problems as yet await solution, and the complexity of the issues is too great to admit of any summary which would be at once brief and comprehensible. All observers are agreed as to the actual facts mentioned above, and at this we may leave the matter. The essential facts of hæmolysis hold good for the organisms of typhoid and dysentery as well as cholera, and we are justified in believing that other antibacterial serums act in a similar manner.

(2) *Agglutination*.—The phenomena of agglutination were brought into general notice by the work of Durham, Grüber, and Widal, which established the value of the agglutination test in the diagnosis of typhoid fever. When an antibacterial serum is added to an emulsion of the corresponding organism, the bacteria no longer remain diffused through the emulsion, but aggregate together in clumps. Under suitable conditions the phenomenon can be rendered visible to the naked eye. To a test-tube full of the slightly turbid bacterial suspension the antiserum is added, and owing to the agglutination which takes place the bacteria settle down to the bottom of the tube, leaving the supernatant fluid clear. If agglutination does not occur the suspension remains turbid. Agglutination can also be observed under the microscope in hanging-drop preparations, or by staining smears. The phenomenon of agglutination depends on the presence in the antiserum of bodies termed agglutinins.

Agglutinins are specific within certain limits, but they also show what is called "group action," *i.e.* an agglutinin not only clumps its specific bacillus, but also, though to a less degree, allied species. Thus, a typhoid serum may agglutinate typhoid bacilli in a dilution of 1/1000, paratyphoid bacilli in a dilution of 1/100, *b. coli* in a dilution of 1/30, and the cholera bacillus in a dilution of 1/10, while normal serum clumps all alike in a dilution of 1/10 (Citron). Agglutinins are probably distinct from immune bodies, because serums which are strongly bactericidal may be feebly agglutinative, and *vice versa*. They present, however, certain analogies to immune bodies—they are thermostable, and they become used up in the process of agglutination. They probably contain an agglutinating and a combining (haptophore)



group (Receptor of third order, *vide infra*). The nature of agglutination is little understood. Apparently the bodies of bacteria contain agglutinable substances which give rise to, and are in their turn acted on, by agglutinins. Such *agglutinogens* are not all of one kind; some appear to reside in the flagellæ, others in the bodies of organisms (Theobald Smith). The agglutinins called forth by the flagellæ appear to act in much higher dilutions than the others, a fact which may explain the greater sensitiveness to agglutination of motile bacilli than of non-motile bacilli.

Besides bacterial agglutinins, *hæmagglutinins*, having an analogous action on blood corpuscles, exist.

(3) *Opsonic Action*.—The most important recent advance in connection with the relations of what we may call cellular and humoral immunity is due to the researches of Sir E. A. Wright and his collaborators on opsonins. They estimated the phagocytic power of the leucocytes by counting the organisms ingested by these cells when equal parts of a standard bacterial emulsion and blood were incubated together at 37° for 15 minutes. They further devised methods whereby the respective parts played by corpuscles and serum in the rôle of phagocytosis could be determined, and proved that “blood-fluids modify bacteria in a manner which renders them a ready prey to phagocytes.” To this influence they gave the name *opsonic action*, and to the constituents of the serum which so act, *opsonins* (ὀψωνέω, prepare victuals for). The method adopted (*vide infra*) is to centrifuge blood, pipette off the serum, and wash the corpuscles. Serums and corpuscles can then be tested separately against a standardised bacterial suspension. Working with an emulsion of *staphylococcus pyogenes aureus* and his own corpuscles and serum, Wright found that the number of organisms ingested fell when the serum had been kept for four or five days, or heated to 60° to 65° C. for 10 minutes. When the serum was first allowed to act on the bacteria and then heated, and the mixture thereafter exposed to the action of the corpuscles, phagocytic action was unimpaired. It follows that serum contains some substance which so affects bacteria as to render them a ready prey to phagocytes. This opsonic power of the blood is exerted towards staphylo- and streptococci, *B. pestis*, *M. Melitensis*, *diplococcus pneumoniae*, *B. coli*, Shiga’s bacillus, *D. intracellularis meningitidis*, *B. anthracis*, *B. typhosus*, *B. tuberculosis*, and the cholera vibrio. It is not exerted towards Löffler’s bacillus or *B. xerosis*.

The opsonic action of serum is greatly increased by the process of immunising against an organism. The nature of opsonins is uncertain. They are of two main types: the opsonins of normal serums, and the opsonins of immune serums, which differ from those of normal serums in withstanding heat, and in being specific. The latter, therefore, may be regarded as true antibodies, comparable to agglutinins.

By comparing the number of bacteria ingested in (a) a mixture of *normal corpuscles, bacterial suspension, and normal serum*, and (b) *normal corpuscles, bacterial suspension, and the serum of a patient suffering from a bacterial disease*, a ratio, called the *OPSONIC INDEX*, is obtained. In cases of localised infection with *staphylococcus aureus*—*e.g.*, sycosis, boils, etc.—Wright invariably found this ratio lower than normal—from .1 to .87, 1.0 being normal. The inoculation of such patients with a vaccine of dead staphylococci is followed, first, by a temporary fall in the index (“negative phase”), and then by a more prolonged rise



("positive phase") to, or above, normal. Coincidentally with the rise in the opsonic index there is a great amelioration of the lesion due to the bacterial invasion. In connection with the subject of bacterial invasion, Wright lays great stress on what he terms the *bacteriotropic pressure*, i.e. the mass effect exerted on the invading bacteria by the protective substance contained in the body fluids. This does not stand at the same level throughout the organism. In fatal typhoid or Malta fever, for instance, the agglutinating action may be as much as 200 times greater in the circulating blood than in the spleen pulp. Bacteria live and multiply in these regions of lowered bacteriotropic pressure. Thus in the case of an abscess the opsonic power of the pus serum was found to be only one-sixth of that of the blood. Wright's work on opsonins has chiefly been made use of and extended in connection with tuberculous infection. Tubercle may be either localised or general, and attended with constitutional disturbance. In localised tubercle the opsonic index is low; in the generalised form it may be either low or high, up to as much as twice normal. When the infection is acute the opsonic index rises and falls within wide limits, because the patient is inoculating himself with successive doses of tubercle, and in consequence negative and positive phases are alternating with one another. The question naturally arises, Is the low opsonic index in localised tuberculous and staphylococcal infection a cause, or a result, of the bacterial invasion. Wright is of opinion that it is an evidence of failure of the defences of the organism, and that to it the infection is due.

(*Precipitines*.—When an animal is immunised with the serum of a different species, precipitines appear in the serum of the former, and confer on it the power of causing a precipitate, or cloudiness, in the serum used for immunisation. The reaction is so delicate that  $\frac{1}{1000}$  c.c. of the serum used for immunisation can be detected. The reaction is, within limits, specific. It is always most marked towards the serum of the particular species used, but serums from allied species give a similar though less marked reaction. Thus an anti-human serum gives a slight precipitate with the serum of the anthropoid apes.)

THEORIES OF IMMUNITY.—Two theories, Ehrlich's and Metchnikoff's, fall to be considered.

1. EHRlich's SIDE-CHAIN THEORY.—Although many criticisms have been levelled at it, the "side-chain" theory may be said to receive general acceptance in its main outlines as a working hypothesis of the nature of immunity. It must be remembered that it is a theory only, and that it will probably require modification in the future. Some of its details are open to question, yet as it, more than any other, offers a fairly coherent explanation of many of the phenomena of immunity, it deserves some consideration here.

Ehrlich looks on the neutralisation of toxin by antitoxin as a chemical, not a physiological process, and in this the majority of observers agree with him. In standardising diphtheria toxin against a standard serum of which a given quantity was able to neutralise 100 minimum lethal doses of toxin, certain anomalies occurred:—(1) A less quantity of toxin than 100 M.L.D. neutralised the serum, and (2) to a neutral mixture of toxin-antitoxin more than one extra M.L.D. of toxin had to be added in order to kill a guinea-pig within the conventional time. Ehrlich explained these discrepancies by showing that in crude toxin some of the toxin molecules underwent modification to toxoids, which, though almost non-poisonous, could still combine



with antitoxin. Their combining affinity might be equal to, greater than, or less than, that of toxin. Where a crude toxin *plus* toxoid of low affinity is used to neutralise antitoxin, and more toxin is subsequently added to the neutral mixture, the first molecules to be set free will be the loosely combined non-poisonous toxoids, and until these are all liberated no free toxin will be present, and no poisonous effect produced. Variations in the number of M.L.D. of crude toxin required to neutralise completely a standard antitoxin depend on the relative amount of toxin and toxoid present, while the fact that more than one M.L.D. is needed to convert a neutral into a lethal mixture arises from the presence in the neutral mixture of loosely combined non-poisonous toxoids, which go on being liberated, and having their places taken by the added toxin, which is thus rendered innocuous. From the above observations Ehrlich assumed that the toxin (toxoid) molecule consists of two groups, one a combining (*haptophore*), the other a poisonous (*toxophore*) group.

Ehrlich conceives of living cells as possessed of constitutions analogous to the ring of the Benzene molecule, to which, as a centre, outlying molecules are attached. Those outlying molecules (*side chains* or *receptors*) are supposed to subserve the nutrition of the cell by combining with food molecules, oxygen, etc., circulating in the blood. They are, also, the mechanism by means of which toxins act on the cell; the *haptophore* group of the toxin molecule combines with a corresponding side-chain and brings the *toxophore* group into relation with the cell. In consequence the cell may die, or, short of that, the side-chain may be destroyed. In the latter event the cell produces new side-chains to replace those which have been damaged, and at last, as the result of repeated doses of poison, these side-chains are manufactured in excess of the cell's needs, and are thrown off into the blood. When the *haptophore* group of a toxin molecule combines with a free side-chain the *toxophore* group is impotent, as it can no longer link itself to, and damage, the tissues. Antitoxin is simply blood serum containing large numbers of free side chains.

The side-chain theory also explains the facts of hæmolysis. When an animal receives a large dose of heterologous blood cells it may be killed. It is supposed that death is caused by the union of the red blood corpuscles, or their products, with certain somatic cells. Should the dose be insufficient to kill the animal, immunity is gradually developed (sometimes supersensitisation, *vide infra*), and, as has been shown, an immune serum containing complement and amboceptor can be obtained, the amboceptor, it will be remembered, having the power of linking itself to red corpuscles. Like antitoxin, this immune serum owes its properties to containing side-chains which the attack of the injected red blood corpuscles had stimulated the body cells to cast off in excess. These side-chains constitute the amboceptor, which attach themselves to red blood corpuscles on the one hand and complement on the other, whereby the latter is enabled to lyse the former. Amboceptors, therefore, have two affinities—*cytophile* and *complementophile*. The action of complement is conceived of as resembling that of a ferment; it must also possess two groups—*haptophore*, by which it anchors itself to amboceptor; *zymophore*, by which it destroys the cells. By a well-known simile, the cell is a lock, the amboceptor a key, the complement the hand which turns the key. Many hands may do this, but only one key will fit the lock.



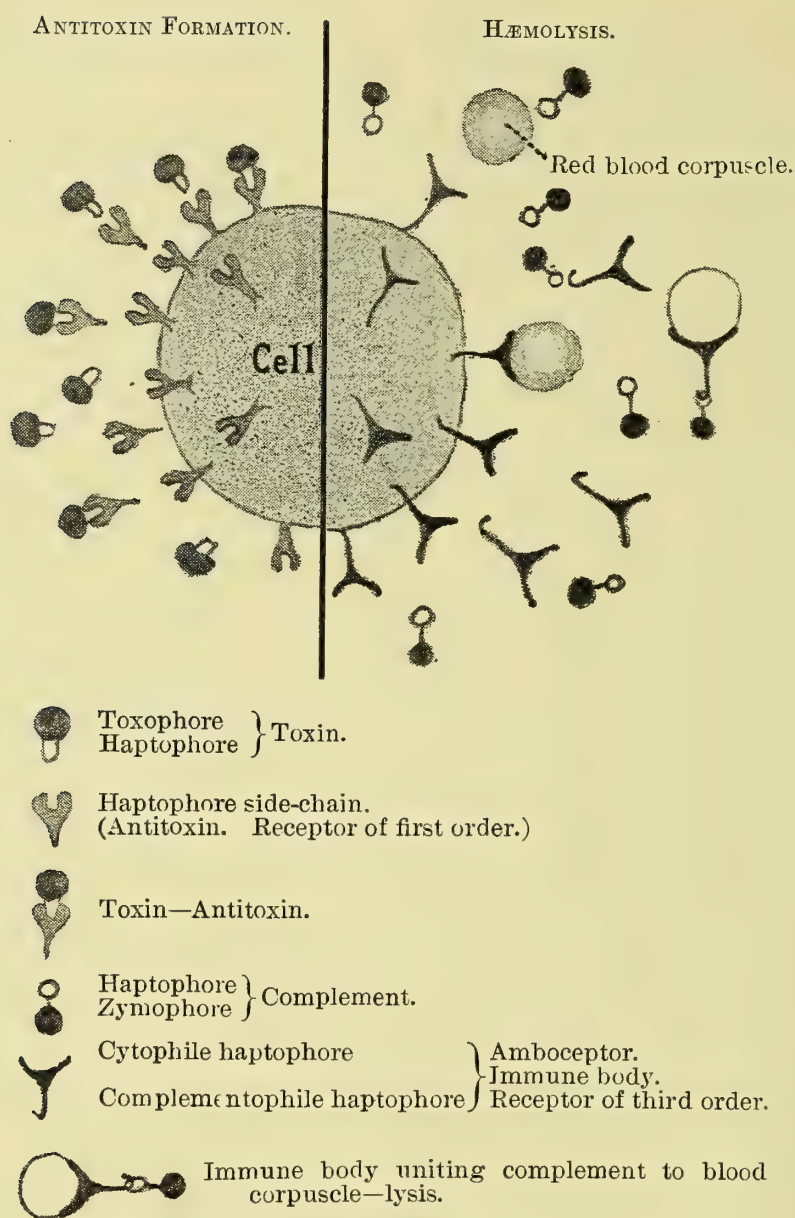


FIG. 1.

Ehrlich supposes that three varieties of side-chain exist. (1) *Receptors of the first order.* These are single haptophore groups by which toxins or food molecules become anchored to the cells. Antitoxin molecules are receptors of the first order. (2) *Receptors of the second order.* The side-chains consist of two groups—one haptophore, and the other possessed of some other property—digestive, agglutinative, precipitating, etc. (3) *Receptors of the third order.* These consist of two haptophore groups, to one of which the food molecule anchors itself, while the other has an affinity for some molecule possessed of digestive properties. Amboceptors, which need for their bactericidal or hæmolytic action the co-operation of complement, are receptors of the third order. The mechanism concerned in immunity is that through which food is assimilated by the cells, and on which the normal nutrition of the tissues depends.

2. METCHNIKOFF'S THEORY OF PHAGOCYTOSIS (see *Encyclopædia Medica*, Vol. V. p. 258).—According to this theory resistance to bacteria depends on phagocytosis. In man there are two main varieties of phagocytes—the polynuclear leucocytes (*microphages*), and certain large cells of the tissues which have the power of ingesting bacteria (*macrophages*). Insusceptibility to a disease results from phagocytosis sufficiently active to destroy bacilli, moderate susceptibility goes along with a local leucocytosis and inflammation with destruction of the invading organisms,



great susceptibility with slight, or absence of, leucocytosis. During the immunisation of a susceptible animal absence of phagocytosis may be replaced by active phagocytosis (positive chemotaxis). This Metchnikoff explains as being due to stimulation of the leucocytes.

The digestion of bacteria by phagocytes is due to ferments (cytases) which are normally present in the cells, but escape into the serum when the cells are injured. In the serum these cytases constitute the complement. The amboceptor of an antibacterial serum fixes itself to the organisms and aids the action of the cytase whether the latter be met with in the cells (in phagocytosis) or in the serum (after it has been set free by phagolysis). Extracellular digestion of bacteria cannot occur unless phagolysis has taken place. Amboceptors are derived from leucocytes, but not all of them are set free in the serum; if they remain in the cells the power of intracellular digestion is increased.

Thus Metchnikoff's theory is not, on the whole, contradictory to Ehrlich's; he approaches the question from a different standpoint, and looks chiefly on the body cells as the defences against bacteria. The phagocytic theory harmonises fairly well with the side-chain theory in so far as antibacterial serums are concerned; it does not, however, satisfactorily explain antitoxic action, and fails to take into account the importance of opsonins in phagocytosis. Metchnikoff's view that increased phagocytosis is due to direct stimulation of the leucocytes is contradicted by Wright's work on the development of opsonic action.

**SUPERSENSITISATION.**—The curious fact has been observed, that animals highly immunised against tetanus may yet succumb to minute doses of toxin, and the nature of this "paradox reaction" has recently been made the subject of much study. Under the names *Supersensitiveness*, *Anaphylaxis*, and *Allergie*, a number of phenomena of this paradox nature have been described, and the results of these investigations have been applied to the interpretation of some of the clinical manifestations of disease, and to the practical ends of diagnosis.

Theobald Smith observed that whereas a normal guinea-pig suffers no harm from the injection of 5 c.c. horse serum, a guinea-pig which has been previously treated, a fortnight or so earlier, with a minimal dose ( $\frac{1}{10000}$  to  $\frac{1}{1000}$  c.c. is enough) in most cases succumbs to a subsequent dose of 5 c.c. (Theobald Smith's phenomenon). Richet proved that second injections of the poison of actinia—a marine animal which grows near the roots of sponges, and causes sponge divers' disease—were much more toxic than first injections; if the animal survived, however, the symptoms were of shorter duration. He coined the word *Anaphylaxis* to denote supersensitiveness of this kind. Pirquet employs the word *Allergie* in much the same way. By it is meant the altered reactivity of an infected animal to a second infection with the same poison; the expression is evidently wider in its connotation than *Anaphylaxis*.

The exact mechanism by which supersensitisation is brought about is not known. The condition, once established, persists for a long period of time, and may follow the injection of minute doses of either heterologous serums or bacterial toxins. Supersensitiveness is specific; the substances which evoke it (allergens—Pirquet) are thermostable. The condition of supersensitiveness is characterised by:—(1) Shortening of the normal incubation period of the particular infection; (2) diminished duration of the symptoms produced; (3) susceptibility to doses of infective agents which would not affect normal individuals.



Clinically, anaphylaxis is of importance in the following conditions:—

(1) *Serum Disease*.—In a considerable proportion of patients treated with diphtheria antitoxin (54·6 per cent. according to the statistics of the Belvedere Fever Hospital) the symptoms collectively known as “serum disease” ensue. They are due to the horse serum used as a vehicle, not to the antitoxin itself. The leading symptoms are pains in the joints and urticarial, erythematous, or measly rashes, with fever. They are often heralded by adenitis. Serum disease never follows a first injection immediately; there is an incubation period of about nine days, during which there is a leucocytosis, and during which, presumably, antibodies are being formed. The events of an attack of serum disease may last for a number of days. What has been described may be termed a “normal reaction;” when, however, repeated doses of serum are given, the symptoms no longer pursue the normal course: (1) The reaction sets in without the intervention of the normal latent period; it may occur on the 4th or 5th day (“accelerated reaction”), or within a few hours of injection (“immediate reaction”). (2) Whereas a normal attack of serum disease runs a course of a good many days, or even several weeks, accelerated or immediate attacks are of shorter duration; the symptoms may be so severe, while they last, as apparently to endanger life, or they may consist merely of local rashes at the seat of injection. A further important point must be noted: time is required for the development of supersensitisation. Hence the accelerated or immediate reaction is only seen when an interval of at least ten days has elapsed between first injection and that which gives rise to the symptoms. On the other hand, when once the condition has become established it may persist for many years, hence any second injection of a serum, even after a long period of time has elapsed, may provoke an abnormal reaction. The practical deduction, therefore, is to avoid reinjections after the tenth day as far as possible, and if a second injection is required, to give it within a week of the first. Injections in rapid succession do not cause an altered reaction. Patients who have previously escaped serum disease may react to the later injections (after the 10th day). No matter how threatening the symptoms, serum disease is probably never fatal, hence, when serum is required, it should never be withheld on account of the possibility of reaction. Serum disease is least likely to occur in bad cases of diphtheria.

(2) *Vaccinia and Variola*.—A primary vaccination runs a definite course—papulation and areolation on the 4th-6th day, the papule growing daily until the 8th-11th day. In secondary vaccinations the insertion often “takes” earlier, and the reaction subsides more quickly. Pirquet finds that in serial daily vaccinations of the same person the later insertions show evidences of the development of anaphylaxis. Insertions made after the appearance of the primary areola never become areolated; they become papular immediately, and attain their maximum development within twenty-four hours. It is a not infrequent experience, that after performing a secondary vaccination in an adult the point of insertion begins to look angry and to show small vesicles about the 2nd or 3rd day—to appear as though it were going to “take” satisfactorily—but at the end of a week all the reaction has died away. Such accelerated, abortive reactions are apparently due to anaphylaxis.

(3) *Tuberculosis*.—The various specific tuberculin tests (*e.g.* Calmette’s oculo-reaction—*vide infra*) depend on the existence of anaphylaxis. The antibodies which the tuberculous focus has called into being, and



which are distributed throughout the body, combine with the inoculated toxin and cause a local reaction—cutaneous, subcutaneous, or ocular, as the case may be.

(4) *Hay Fever*.—In susceptible persons an attack of hay fever may be produced at any time of the year in a few moments by inoculation with a small dose of pollen (*vide* HAY FEVER).

(5) *Syphilis*.—In reinfections in monkeys the incubation period is curtailed. Syphilitics in all stages show local reactions to syphilitic virus.

DIAGNOSTIC ASPECTS OF IMMUNITY.—Citron's classification gives a good idea of the scope and present possibilities of immunity-diagnosis.

I. SERUM DIAGNOSIS, including (a) *the diagnosis of infectious diseases*, and (b) *the diagnosis of bacteria* by specific protective substances in the serum, also applicable to the detection of heterologous albumins. The protective bodies which are made available for diagnostic purposes are:—

1. Agglutinines (*e.g.* typhoid fever—Widal reaction—and typhoid bacilli).

2. Precipitines (*e.g.* specific blood tests).

3. Antitoxines (*e.g.* serum of convalescents from diphtheria untreated by antitoxine—of no practical importance).

4. Amboceptors (*e.g.* sero-diagnosis of syphilis—complement fixation).

5. Opsonines.

II. ACTIVE IMMUNISATION.—Not much used. An actively immunised animal does not react to the specific infection. The nature of a doubtful infection may be determined (a) by the response of an actively immunised animal to it; or (b) by actively immunising animals with it, and then noting their reactions to known infections.

III. ANAPHYLAXIS.—The specific tuberculin tests.

Of these methods of diagnosis, the specific blood tests (I. 2), the sero-diagnosis of syphilis (I. 4), the opsonic index (I. 5), and the tuberculin tests (III.) merit further description.

1. *The Biological Blood Test* (Uhlenhuth—Wassermann—Schütze).—This depends on the development of precipitines. Defibrinated human blood or blood serum is injected into the peritoneal cavity of a rabbit at intervals of two or three days until six doses have been given; the animal is bled a week after the last injection. The immune rabbit serum is then a specific precipitant for human serum, but not for the serum of domestic animals. Decomposing blood, menstrual blood, and blood which has been heated to 60° C. give the reaction. The immune serum used should be tested against human blood in order to ascertain whether it is active. A very dilute solution of the blood-stain in 1·6 saline solution is prepared, and filtered until it is clear. To 4 or 5 c.cm. of this solution in a test-tube there is added ·5 c.cm. of the immune serum, and the whole is kept at a temperature of 38° C. Precipitation begins within from a few minutes to half an hour; first a faint cloudiness develops, which becomes more dense and ultimately gives a flocculent precipitate. As in the case of the agglutination test, the time of appearance and the dilution required are important. Heterologous serums other than human blood may give a faint haziness, so that the test cannot be regarded as positive unless at the end of an hour a true flocculent precipitate has formed with much diluted blood on the addition of two or three drops of anti-serum.

2. *Serum Diagnosis of Syphilis*.—The sero-diagnosis of syphilis which is associated with the name of Wassermann is based on the principle of complement fixation. The method is too complicated to be carried



out except in a laboratory; it is said by those who have practised it to be as reliable in the diagnosis of previous or active syphilis as is the Widal test in typhoid fever. The test depends on the fact that when syphilitic virus is mixed with the serum of a syphilitic patient the antibodies in the latter unite with the virus and with complement. The complement is thus fixed, and is not available for uniting with any other antibodies. If, on the other hand, a non-syphilitic serum (containing, therefore, no antibodies) is mixed with syphilitic virus there is no fixation of complement, which is consequently free to combine with any other antibodies. The diagnosis of a syphilitic serum, therefore, depends on the recognition of the complement, and the presence or absence of free complement is determined by adding to the mixture of virus, complement, and suspected serum, inactivated hæmolytic serum and red blood corpuscles. If free complement is present lysis will occur; if the complement has been fixed there will be no lysis. To carry out the test the following are required: (1) Antigens, obtained by extracting the liver of an hereditary syphilitic foetus with salt solution. (2) Antibodies as contained in the suspected serum—blood serum, cerebro-spinal fluid, etc. (3) Complement—fresh guinea-pig's serum 1:10. (4) Hæmolytic serum, from a rabbit highly immunised against sheep's corpuscles, inactivated by heating. (5) Washed sheep's corpuscles. In carrying out the test a complete system of controls is required. Citron employs ten, and gives the following scheme for their employment:—

		Result Expected
1. .2 c.c. syphilitic antigen + .2 syphilitic serum + .1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	no hæmolysis
2. c.c. syphilitic antigen + .1 syphilitic serum + .1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	partial „
3. ——. .2 syphilitic serum + .1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	complete „
4. .2 c.c. syphilitic antigen ——. + .1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „
5. .2 c.c. syphilitic antigen + .2 normal serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „
6. ——. .2 normal serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „
7. .2 c.c. extr. normal liver + .2 syphilitic serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „
8. .2 c.c. extr. normal liver + .2 normal serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „
9. .2 c.c. extr. normal liver ——. + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „
10. ——. 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 % sheep's blood	„ „

In the tubes 3, 4, 6, 9, and 10 the absent substance is replaced by 1 c.c. .85 saline solution

Results estimated thus. Tubes 1=no hæmolysis and 2 no hæmolysis =syphilis++++  
 1=no hæmolysis and 2 partial hæmolysis =syphilis+++  
 1=no hæmolysis and 2 hæmolysis =syphilis++  
 1=partial hæmolysis and 2 hæmolysis =syphilis+  
 1=almost complete hæmolysis and 2 hæmolysis=syphilis(?)  
 1=complete hæmolysis and 2 hæmolysis =no syphilis

*Value of Wassermann's Reaction.*—Non-syphilitic persons never give a positive reaction; a large proportion of syphilitic persons give it. A positive reaction, therefore, is proof of syphilis; a negative one renders it unlikely, but does not disprove it. Syphilitic patients may give a negative reaction (1) during the primary stage of the disease; (2) during the second stage, in rare cases only; and (3) during the later stage, if thorough treatment has effectively driven away all symptoms. In general terms, a positive reaction is given in about 80 per cent. of syphilitic cases. Time is required for the development in the patient's serum of antibodies, hence the reaction may be negative at first, and appear after six or eight weeks have elapsed. The secondary cases which do not react are generally in the early eruptive period.



In tertiary cases the reaction is very constant. Tabes, general paralysis, and aneurism give a high percentage of positive results. In general paralysis both blood serum and cerebro-spinal fluid give the reaction; in tabes the blood serum commonly gives it, but the cerebro-spinal fluid rarely does so. A positive reaction from the cerebro-spinal fluid is said to be almost pathognomonic of paralysis.

Under mercurial treatment a positive reaction may become negative. The longer the syphilitic virus has been active, and the oftener relapse has occurred, the more constant is the reaction. The earlier mercurial treatment is instituted, and the more effectively it is carried out, and the shorter the time since the last course was undergone, the fewer the antibodies in the serum and the less marked the reaction. Wassermann's test, therefore, promises to afford a means by which the efficacy of treatment can be estimated, and the need for its renewal determined. Since the original test was introduced it has been simplified in various ways. Some of these newer modifications are discussed under the rubric Syphilis.

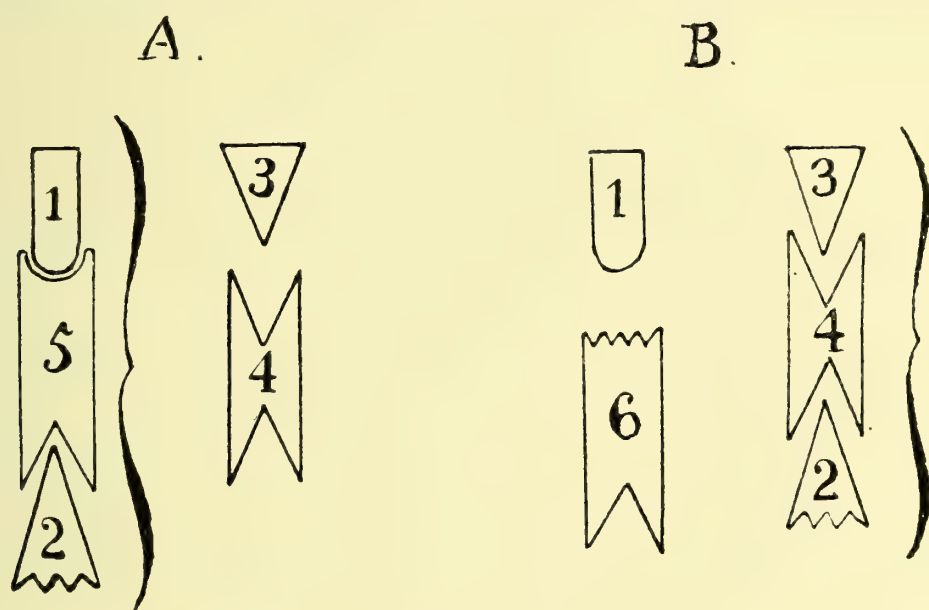


Diagram illustrative of complement fixation in diagnosis.  
 1=Typhoid bacilli. 2=Complement. 3=Red blood corpuscles. 4=Haemolytic amboceptor. 5=Typhoid amboceptor. 6=Cholera or other amboceptor.  
 A. Fixation of complement to typhoid amboceptor and bacilli; no hæmolysis.  
 B. No fixation of complement to cholera amboceptor and typhoid bacilli; free complement links itself to hæmolytic immune body=hæmolysis.

*Complement Fixation in the Diagnosis of Other Diseases.*—The method has been used in the diagnosis of typhoid fever, cerebro-spinal meningitis, gonococcal infections and other diseases. In these cases bacterial extracts made from cultures are used as antigens. In Wassermann's method the original feature was the use of an extract of an organ. The above diagram, modified from Citron, will render the method clear (Fig. A. B.).

Fixation of complement may also be used to identify bacteria, or antigens, as well as antibodies, using in this case a known antibody, just as in other cases a known antigen is employed. The method of complement fixation is important as being the most delicate of all the immunity tests, and as being applicable to soluble albumins as well as bacterial antigens.

3. *The Opsonic Index.*—The chief diagnostic importance of the opsonic index is in connection with tuberculosis.

*Technique.*—1. *Preparation of the Bacterial Emulsion.* (a) Emulsions of tubercle bacilli are prepared by thoroughly grinding up a mass of dead culture (which can be procured commercially) in an agate mortar



with 1·5 per cent. saline solution, and then centrifuging. Alternatively, the emulsion prepared by grinding in the mortar may be stored in small sealed tubes, and used as described under. (b) In either case the bacilli should be sterilised by heating for half an hour on three consecutive days. (b) Emulsions of pyogenic cocci are made by rubbing up a little of a twenty-four hours' culture with normal saline, and centrifuging so as to deposit clumps of bacilli. A slightly opalescent suspension results. 2. *Washed Leucocytes*. A few drops of the observer's blood are allowed to drop directly into a test-tube of 1·5 per cent. sodium citrate dissolved in normal saline. The mixture is thoroughly centrifuged, and the supernatant fluid pipetted off; more saline is added, the mixture is again centrifuged, and the fluid removed; then the process is repeated a second time. After this the upper layer of corpuscles, which is rich in leucocytes, is pipetted off into a watch glass for use. 3. *Blood* is collected in a pipette, with a specially curved end; the ends are sealed and the tube is hooked by its curved end to the centrifuge. On centrifuging, the corpuscles collect at the straight end, the tube is broken across, and the serum pipetted off. Having made these preparations, we mix equal parts of serum, washed corpuscles, and bacterial emulsion, using as a measure a capillary tube with a mark made by an oil pencil about an inch from one end, and provided at the other with a rubber teat. The serum is drawn up to the mark, then an air bell is allowed to enter, next the emulsion is sucked up, and another air bell, then the corpuscles. The contents of the tube are then blown out on to a slide, thoroughly mixed, and re-aspirated into the tube once more. The ends of the tube are then sealed, and the whole is incubated at 37° C. for fifteen minutes. A control preparation with normal serum is also made in the same way. From the contents of the tubes films are made on slides which have been rubbed once or twice with the finest emery paper (to facilitate an even smear), and stained with Leishman's stain for cocci, or, after fixing with corrosive sublimate, with carbol fuchsin and methylene blue for tubercle bacilli. The number of bacteria ingested by 50 polynuclear leucocytes is counted, and an average struck. From this the index is obtained, *e.g.*—

Patient's serum + corpuscles + bacteria. Average bacteria per leucocyte, 1·5.

Normal serum + corpuscles + bacteria. Average bacteria per leucocyte,

3. Opsonic index  $\frac{1\cdot5}{3}$  or ·5.

The chief criticism which has been brought against the value of determinations of the opsonic index concern the limits of its experimental error. Wright claims that in his laboratory the error seldom exceeds 5 per cent.; others report much less favourably. At present this aspect of the question is still undecided. Rivière points out that it is as necessary to include a sufficient number of ingested bacteria in the count as to enumerate 50 or 100 leucocytes. At least 150 bacteria should be counted, irrespective of the number of phagocytes containing them. The emulsion used ought therefore to be thick enough to give a phagocyte index of 2.

*Diagnostic Significance of the Opsonic Index.*—For tuberculosis Wright lays down the following rules:—

1. "Where an isolated blood examination reveals that the tuberculo-opsonic power of the blood is low, we may, according as we have evidences of a localised bacterial infection or of constitutional disturb-



ance, infer with probability that we are dealing with tuberculosis, in the former case with a localised tubercular infection, in the latter with an active systemic infection."

2. "When an isolated blood examination reveals that the tuberculo-opsonic power of the blood is high, we may infer that we have to deal with a systemic tuberculous infection which is active, or has recently been active."

3. "Where the tuberculo-opsonic power is found normal, or nearly normal, while there are symptoms suggestive of tuberculosis, we are not warranted, apart from the further test described below, in arriving at a positive or negative diagnosis."

4. "Further test:—When a serum is found to retain in any considerable measure, after it has been heated to 60° C. for 10 minutes, its power of inciting phagocytosis, we may conclude that 'incitor elements' have been elaborated in the organism either in response to auto-inoculations occurring spontaneously in the course of tubercular infection, or, as the case may be, under the artificial stimulus supplied by the inoculation of tubercle vaccine."

5. If the opsonic power of the fluids from the focus of invasion differs from that of the blood, tubercle is indicated; if it is the same, the infection is non-tuberculous.

6. Some observers (Stewart, Peel, Ritchie) regard single estimations as inconclusive, as both tuberculous and non-tuberculous cases fall within and without normal limits. The effect of a small dose of tuberculin on the index is of diagnostic value. In tuberculous subjects a "negative phase" follows, succeeded by a "positive phase"; in the non-tuberculous the negative phase is absent. (Lawson and Stewart.)

The determination of the opsonic index in other than tubercular and pyogenic infections has so far given results of more scientific than practical interest. The amount of time which opsonic work demands militates greatly against its general adoption, even by those who have laboratory facilities at their disposal. Further reference will be made to the subject under the headings of some of the various bacterial diseases.

4. *Specific Tuberculin Tests*.—These furnish the only instances of reliable diagnostic reactions dependent on the phenomena of anaphylaxis. Analogous tests for typhoid and other infections have not proved trustworthy. The tests in question are three in number:—(1) Subcutaneous inoculation of Koch's old tuberculin. (2) Pirquet's cutaneous reaction. (3) Calmette's oculo-reaction. The introduction of the two latter has done much to supersede the determination of the opsonic index in the diagnosis of tubercle.

1. *Koch's Subcutaneous Tuberculin Reaction* (1890).—Old tuberculin (Meister, Lucius & Brüning), the glycerine extract containing the toxins of the tubercle bacillus, introduced by Koch in 1889, is employed. Subcutaneous injections of small quantities give rise in tubercular persons to (a) general reaction—fever, malaise; (b) focal reaction at the lesion; (c) occasionally to a local reaction at the point of injection—"stich-reaction."

The general reaction is the most important. As a rule the temperature begins to rise in six or eight hours, and reaches a maximum in twelve hours; in exceptional cases it may occur earlier or later. A rise of temperature of 1° F. is considered positive. The focal reaction may be visible when the disease is on an exposed part—thus, a patch of



lupus becomes hyperæmic; when the disease is deeply seated other signs of hyperæmia may be detected—*e.g.* increase of crepitations in pulmonary mischief. The local reaction is shown by swelling and tenderness at the point of injection.

*Technique.*—It is customary to begin with  $\frac{1}{10}$  mgr., and if no reaction occurs to repeat the injections at intervals of four days. Some increase the dose if the first injection is negative, giving in succession  $\frac{1}{10}$  mgr., 1 mgr., 5 mgrs., and 10 mgrs. Others, instead of increasing the dose, continue with  $\frac{1}{10}$  mgr.- $\frac{1}{5}$  mgr., even when the first injection has been negative, because the susceptibility to tuberculin rises with successive doses, and even healthy persons may react to large quantities. If a doubtful reaction is got, the dose of  $\frac{1}{10}$  or  $\frac{1}{5}$  mgr. should be repeated. In children it is advisable to restrict the dose to  $\frac{1}{10}$  mgr., repeated if necessary. When the test is being applied the rectal temperature should be taken every two hours. It is generally agreed that when applied in the manner described the test is very reliable, and not dangerous, provided that the following contra-indications be kept in view:—

1. The test should not be used when tubercle bacilli can be demonstrated.

2. Fever invalidates the test. This is the most serious practical drawback, as a temperature of 99° F. in the rectum is sufficient to render it worthless.

3. It is contra-indicated in patients suffering from heart or kidney disease, epilepsy, diabetes, arterio-sclerosis; when hæmoptysis has occurred, or where there is a suspicion of miliary tuberculosis.

This is regarded as the most certain and delicate test for tuberculosis. Some healthy persons react, probably because they harbour obsolete tubercle, and this detracts to some extent from its clinical value.

2. *Pirquet's Cutaneous Reaction.*—For this, old tuberculin diluted with 2 parts of normal saline and 1 part 5 per cent. carbolic-glycerine is employed. A drop is placed on the skin, and the epidermis is scarified through it. A control scarification through normal saline should be made an inch or two distant. It is important to make the two abrasions equal in depth and extent, so that no doubt may arise as to the result; and to attain this the best instrument to use for vaccination is a small dental burr, the effect of which can be exactly regulated. A positive reaction shows itself in from six to eight hours, and attains its maximum in twenty-four hours. According to the intensity of the reaction a papule surrounded by a varying degree of erythema develops. There is sometimes vesiculation, and occasionally slight pigmentation is left behind after the papules disappear. The clinical value of the cuti-reaction is detracted from by the fact that a large number of apparently healthy adults (80 per cent. according to some observers) respond to it, presumably because it reveals obsolete tubercle. It is, therefore, of clinical value only in children under five, some say under two, years. *Statistics:*—For adults, collating Mainini, Wolff, and Goebel, we find 84 positive reactions in 96 cases of tuberculosis; 137 reactions in 195 suspects; and 101 reactions in 128 clinically normal persons. In children, Goebel, Ferrand and Lemaire, Bing, and Pirquet give 95 positive reactions in 128 tuberculous patients; 44 reactions among 68 suspects; and 21 reactions among 93 clinically non-tuberculous.

The cuti-reaction is devoid of risk, and there are no contra-indications to its use.



Moro's salve reaction is simply a modification of Pirquet's test, and presents no advantages over the original method. An ointment consisting of 5 c.c. old tuberculin and 5 grams anhydrous lanolin is rubbed into the skin; a positive reaction is shown by the occurrence of slight dermatitis.

3. *Calmette's Oculo-Reaction*.—Although this test is associated with the name of Calmette, who has done most to popularise it and extend its use, he was actually anticipated in his publication of the method (19th June 1907) by Wollf-Eisner, who independently described it on 8th and 15th May 1907 at meetings of the *Berliner Medizinische Gesellschaft*. Hence in Germany it is also known as the Wollf-Eisner reaction. The test consists in the instillation of a drop of a weak solution of tuberculin into one conjunctival sac; a positive reaction is shown by a mild attack of conjunctivitis.

Wollf-Eisner employed a 10 per cent. solution of tuberculin, while Calmette employs a  $\frac{1}{2}$ -1 per cent. solution, and in order to avoid the irritating action of glycerine on the conjunctiva he uses exclusively dried tuberculin precipitated by 95 per cent. alcohol, dissolved in sterile distilled water. In Wollf-Eisner's method serious conjunctivitis is rather liable to occur, and now the general custom is to use only the weaker—.5 per cent.—of Calmette's solutions. Citron states that a reaction with 1 per cent. tuberculin points with a high degree of probability to tuberculosis. A reaction with 2 per cent. renders it probable, and no reaction with 4 per cent. solution negatives tubercle, unless the patient is cachectic (*vide infra*). He advises that a 2 per cent. solution be dropped into the right eye; if no reaction follows, then 4 per cent. solution is inoculated on the opposite side—if, on the contrary, there is a reaction, the second instillation is made with 1 per cent. solution.

If the reaction is positive the first signs appear in from three to five hours after instillation. There is evident congestion of the palpebral conjunctiva, which quickly becomes œdematous; the caruncle swells and becomes reddened and covered with fibrinous secretion. The vascular engorgement becomes gradually more accentuated, and is accompanied by lachrymation. After six hours the fibrinous exudate increases and collects in shreds in the conjunctival sac. The maximum reaction is attained in from six to ten hours. There is no pain, little discomfort, no chemosis, and no pyrexia. In children the phenomena usually begin to subside in the course of twenty-four or thirty-six hours; in adults they may last a little longer. Three grades of reaction are distinguishable:—(1) slight, which may pass unnoticed unless the inner canthus is carefully compared with that of the opposite eye; (2) moderate, giving the appearances of a mild acute conjunctivitis; (3) violent, resembling purulent ophthalmia. The last is rare when a .5 per cent. solution is used. The Calmette test is of great value; its sole disadvantage is the undeniable, though slight, risk of damage to the eye. This will be referred to later. Campbell has collected statistics up to April 1908. The 4219 cases in his series give these results:—

Tuberculous cases	1675	1426 +	249 -	=	85 per cent. positive.
Suspected tuberculosis	557	289 +	268 -	=	52 per cent. positive.
Non-tuberculous cases.	1987	169 +	1818 -	=	91.5 negative.

*Comparison of the Tuberculin Tests*.—It is unanimously agreed that all three tests fail in advanced tuberculosis, in general military



tuberculosis, and in tuberculous meningitis. This fact probably explains the 15 per cent. or so of negative results in tuberculous patients. As regards the relative value of the tests, it is not easy to compare the statistics of different writers, but it seems certain that both the subcutaneous injection, and the cutaneous inoculation of tuberculin are more delicate than the oculo-reaction. They may reveal latent or obsolete tubercle in persons clinically healthy. This is less likely to occur with the oculo-reaction, which is practically, therefore, the most useful of the three.

*Relation of the Intensity of the Reaction to the Severity of the Disease.*—As has been said, advanced cases give no response, and on the whole the intensity of the reaction is inversely proportionate to the grade of infection. Wollf-Eisner distinguishes between marked, mild, and delayed cuti-reactions, associating the first with mild and incipient tuberculosis, the second with advanced cases, and the third with the absence of clinical tuberculosis.

*Danger to the Eye in the Oculo-Reaction.*—That a certain risk attaches to the conjunctival test cannot be disputed. It is greatest when strong solutions are employed, and many of the reports of disaster come from Germany, where a 10 per cent. solution was originally advocated. Before the test is applied, the eye should be carefully examined, and the test should only be proceeded with *if the eye appears perfectly healthy and free from any evidence of previous disease. In old people, and in scrofulous children special care is required, and the tuberculin should not be used stronger than  $\frac{1}{4}$ - $\frac{1}{2}$  per cent.* Patients from trachoma districts should not be subjected to the Calmette test. The test is also useless if a diagnostic injection of tuberculin has been given within the previous six months. It is probably a wise precaution to irrigate the conjunctival sac with sterile saline solution before applying the test. The ensuing conjunctivitis should be treated with boric lotion, and the application of a mild antiseptic ointment (Hydrarg. ammon. grs. v. ad ʒi.) to the edges of the lids. In view of the fact that a sharp attack of conjunctivitis may follow, the test is not suitable for out-patient and dispensary practice, unless effective supervision can be carried out. The permission of the patient should be obtained before the test is applied.

*Reapplication of the Tests.*—In connection with the subcutaneous injection of tuberculin the increasing sensitiveness of the patient with each dose was referred to. In the oculo-reaction the same occurs. Second instillations into the same eye sometimes provoke reactions in persons who have failed to respond to the first test. The diagnostic meaning of these second reactions is doubtful; they may occur in healthy as well as tuberculous persons. The supersensitiveness, however, is probably local, hence if a second test be thought advisable the tuberculin should be dropped into the opposite eye. It is claimed that where this is done a reaction can be obtained in a certain proportion of tuberculous patients who previously gave no response to the test.

It has been found impracticable to differentiate between infections with the bovine and human bacillus by the use of bovine and human tuberculin.

Attempts to adapt the cutaneous and oculo-reactions to the diagnosis of typhoid fever have also failed. Mallein applied in this way is said to give reliable results in cases of glanders in man.



## THERAPEUTIC USE OF BACTERICIDAL SERUMS.

The fact that for bactericidal serums to act complement is essential, is fundamentally important. Let us suppose, for the sake of argument, that by inoculation we can greatly increase the amount of amboceptors, and that we can inject these into the body of a person invaded by the organism in question, we have still to face the fact that (beyond the small quantity which the immune serum contains) there is no more complement than before, and that the amboceptors are only available for the destruction of bacteria in so far as they can be complemented. There is also some reason to believe that excess of amboceptors over available complement is harmful. For under these conditions some of the amboceptors may be anchored to bacteria, and others to complement, whereupon the only way in which the available complement can come into relation with bacteria is by amboceptor uniting to amboceptor, and this is impossible. So far, it has not proved practically possible to increase complement. For one thing, little is known about complements, and the search for a suitable one has been largely at random. Again, to inject complement may simply result in the formation of anti-complement, which will neutralise what already exists. Anti-bacterial serums originally contain the complement of the species from which they were derived, but complement is an unstable body and liable to disappear through lapse of time. It does not follow that the complement present in man will be able to link itself to the amboceptors injected; these, therefore, may prove useless. The whole question of complementing anti-bacterial serums seems to be a crucial point in their future usefulness.

LITERATURE.—The literature of immunity is enormous, and only a few of the chief sources can be given. Current literature is recorded in BAUMGARTEN'S *Jahresbericht*.—KOCH and FLUGGE. *Zeitsch. f. Hygiene u. Infectionen; Centralb. f. Bakteriologie u. Parasitenkunde*. The bibliography in MUIR and RITCHIE'S *Manual of Bacteriology*, 4th ed. (Edin.) 1907, and the list of references in RITCHIE'S article on "Infection" in CLIFFORD ALLBUTT'S *System of Medicine*, vol. ii., 2nd ed. (Lond.) 1906, should be consulted :—OPSONINES.—WRIGHT and DOUGLAS. *Proc. Royal Soc.*, lxxii. p. 357, 1903; lxxiii. p. 128, 1904.—WRIGHT. *Lancet*, ii. p. 1398, 1905 (references).—HEKTOEN. *Journ. Amer. Med. Assoc.*, 12th May 1906 (references).—BOWDITCH POTTER. *Ibid.*, 24th Nov. and 1st Dec. 1906.—FORDYCE. *Internat. Clinics* (Phila.), vol. i. ser. 18, 1908 (references). A series of papers will also be found in the *Trans. Assoc. Amer. Physn.*, vol. xxii. 1907. SUPERSENSITISATION.—Review by PIRQUET. *Ergeb. d. inner. Med. u. Kinderheilk.*, Bd. i. 1908, gives references.—RICHTER. *Presse méd.*, 21st March 1908. SERUM DISEASE.—CURRIE. *Glasgow Med. Journ.*, March 1908. IMMUNITY DIAGNOSIS.—The best general article is by CITRON, in BRUGSCH and SCHITTENHELM'S *Lehrbuch klinischer Untersuchungs-Methoden* (Berlin), 1908. SERO-DIAGNOSIS OF SYPHILIS.—The files of the *Deutsche med. Wochens.*, the *Münch. med. Wochens.* and the *Berl. klin. Wochens.* for 1907 and 1908 contain a number of papers on the subject, of which may be mentioned those by CITRON, *Deutsche med. Wochens.*, 10th July 1907, and *Berl. klin. Wochens.*, 25th Oct. 1907.—WASSERMANN and MEIER. *Deutsche med. Wochens.*, 8th Aug. 1907.—FORNET. *Ibid.*, 10th Oct. 1907.—WASSERMANN. *Berl. klin. Wochens.*, 16th Dec. 1907.—BAB. *Münch. med. Wochens.*, 12th Nov. 1907. SPECIFIC TUBERCULIN TESTS.—During 1907 and 1908 a great many papers have appeared on the ophthalmo- and cutaneous-reactions. Only a few need be mentioned.—CALMETTE. *Presse méd.* (Paris), 19th June 1907.—WOLFF-EISNER and TEICHMANN. *Berl. klin. Wochens.*, 21st Jan. 1908.—PIRQUET. *Deutsche med. Wochens.*, 23rd and 30th May 1907.—WOLFF. *Berl. klin. Wochens.*, 10th Feb. 1908.—COMBY. *Presse méd.*, 10th Aug. 1907.—CAMPBELL. *Montreal Med. Journ.*, April 1908, gives a list of references to oculo-reaction. RIVIERE'S article in *Tuberculosis in Infancy and Childhood* (Lond.), 1908, contains a general review of the tests for tuberculosis, and gives literature. OCULO-REACTION IN TYPHOID.—CHANTEMESSE. *Deutsche med. Wochens.*, No. 39, 1907.—KRAUS. *Wien. klin. Wochens.*, 11th Nov. 1907. IN GLANDERS.—MARTEL. *Berl. klin. Wochens.*, 2nd March 1908.



Infant Feeding.

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ALL recent work on the rearing of infants has led to the conclusion that maternal nursing is infinitely preferable to any form of hand feeding. The more closely the natural process of suckling is studied, the less probable does it appear that any really satisfactory substitute will ever be found. At the same time, some advances in artificial feeding have been made.

DIGESTION OF CASEIN OF MILK.—The views of Van Slyke and Hart are now generally accepted here and in America. The essential point brought out by their work is that the amount of digestion which milk requires depends on the activity of the gastric juices. In the stomach of the newly-born infant it probably undergoes comparatively little digestion, and passes quickly into the bowel, whereas in older infants it offers considerable resistance to digestion. Milk stands alone among foods in possessing this quality, which results from the reactions of casein towards rennin and hydrochloric acid. In explaining these reactions the nomenclature of Van Slyke and Hart will be followed.

Casein is a proteid which contains phosphorus, and exists in milk in combination with lime as *calcium casein* (otherwise known as caseinogen, etc.). On entering the stomach calcium casein is acted on by rennin, hydrochloric acid, and pepsin. Rennin and pepsin exist in the gastric juice from birth; hydrochloric acid appears soon after birth. Rennin can only act on calcium casein if (as is normally the case) ionisable calcium salts are present in the milk plasma. (To digress for a moment from the main argument, we may here state that the effect of sodium citrate in inhibiting rennin action depends on the power of the citrate to diminish the ionisable calcium.) The first action of rennin is to convert the soluble calcium casein into insoluble *calcium paracasein*, a soft curd which, in the absence of hydrochloric acid, is not further affected by pepsin, but passes readily into the intestine. If, however, free hydrochloric acid be present in the stomach, it reacts with the calcium paracasein and converts the latter into *free paracasein*, which is a firmer curd, and is digested by pepsin. If the hydrochloric acid be present in larger amount, a further reaction ensues, paracasein hydrochloride being formed from the free paracasein. This is a denser curd than either of its precursors; it, also, is digested by pepsin.

Several matters of practical interest arise out of the above statement as to the digestion of milk.

1. It brings into prominence the part which milk plays in developing the gastric functions. At each stage of the stomach's development milk will fully tax the powers of the organ, and exercise them to the utmost. We thus see why the milk of the parent animal, though its composition remains practically the same throughout lactation, is as suitable a diet at the end of that period, when the offspring is beginning to be capable of digesting ordinary food, as it is at birth, when the digestive powers are extremely feeble.

2. It also throws light on the functions of curd formation, the object



of which would appear to be to exercise the motor as well as the secretory functions. In this connection Chapin's work may be referred to. He draws attention to the relation which exists between the variations in the milks of different species, and variations in the development of the stomachs of the offspring. According to him, the milk of any animal is specially adapted for developing the stomach of its young in a normal manner—*e.g.* the dense curd of cow's milk is designed to assist in the development of a stomach fitted to deal with the vegetable diet on which the animal subsists.

3. A mechanism of this kind would seem to compensate for slight variations in modifications of milk; it also explains, to some extent, how cow's milk, notwithstanding the gross difference between its curd and that of human milk, is so well borne by most infants. It may, perhaps, account for the fact that in some cases whole milk is tolerated better than a dilution, because if much hydrochloric acid is present in the stomach it may convert all the casein of dilute milk into casein hydrochloride, whereas if whole milk be given the acid is insufficient to do so—in the former case a dense, though small curd forms, in the latter a softer, though larger one.

4. If milk which has soured, but has not reached the stage of curdling, be swallowed, rennin action takes place as above, and then both lactic and hydrochloric acid are available to react with the calcium paracasein, paracasein lactate and hydrochloride being formed. The excess of acid leads to the production of large quantities of tough curd. In milk which has soured completely and formed a curd outside the stomach (*e.g.* buttermilk), casein lactate, not paracasein lactate, is formed. The curd of casein lactate is light, and undergoes no further change when it comes in contact with rennin and hydrochloric acid. Thus, buttermilk is a digestible food, partially soured milk a very indigestible one.

CAUSES OF COW'S MILK DISAGREEING.—It is now thought that in the past too much importance has been attached to the proteid of cow's milk as a cause of difficulty in infant feeding. Holt has drawn attention to the dangers which result from excess of fat, and quantities which were formerly advised are now looked upon as harmful. Probably it is never desirable to order a milk mixture containing more than 3 per cent. to 3·5 per cent. of fat. Czerny and Keller represent the extreme school of opinion in this respect. They deny that there is any evidence that the proteid of cow's milk is either more difficult to digest, or less perfectly assimilated, than that of human milk, and they blame the fat of cow's milk for nearly all the difficulties which arise in connection with hand feeding. They go so far as to attribute many cases of marasmus to this component of milk; their views will, however, be found more fully referred to elsewhere (see INFANTILE ATROPHY).

Another aspect of the failure of cow's milk to promote normal growth in some cases has recently been much studied in Germany. Attempts have been made to show that it acts as a heterologous albumin, and thus may in some cases be positively harmful. This, however, has never been proved, and the evidence is rather against it. It is, however, probable that a young animal derives from its mother (particularly during the colostrum period of lactation) vital products of the nature of enzymes, which it cannot obtain from any other source. The special importance of maternal nursing during the colostrum period is very strongly insisted on by some workers from the biological point of view.



THE ADDITION OF ALKALIES TO MILK.—From the chemical point of view, human milk is faintly acid, not alkaline, as formerly stated. That the addition of alkalies (lime water and sodium bicarbonate) renders cows' milk more digestible has long been recognised, but a clear appreciation of their action has only recently been arrived at. Their action is two-fold: they combine with calcium casein to form compounds on which rennin has no action; they neutralise the hydrochloric acid of the gastric juice, and thus inhibit peptic digestion. Lime water is much more powerful in rennin-inhibitory action, and sodium bicarbonate in acid-neutralising power. Fifty c.c. of lime water equal 3 grs. of sodium bicarbonate in acid-neutralising power, and 35 grs. of sodium bicarbonate in inhibiting rennin. Thus, if it be desired to diminish rennin action without eliminating gastric digestion by hydrochloric acid and pepsin, lime water should be chosen; if it be desired to cut out gastric digestion altogether, sodium bicarbonate should be used. Lime water is generally added in the proportion of 1.5 ozs. to the pint of milk, sodium bicarbonate in the proportion of 1-2 grs. to the oz. Milk thoroughly alkalinised by the addition of 2 grs. of sodium bicarbonate to each ounce probably to a large extent escapes gastric digestion. Lime water is therefore most useful in intestinal indigestion (colic, and passage of loose stools with mucus and "curd"); sodium bicarbonate in gastric indigestion, with vomiting of curd.

METHODS OF FEEDING.—Turning to the newer methods of feeding which have come into vogue, it may be said that even in America percentage feeding has, to some extent, lost ground, and that there is less tendency now than a few years back to insist on the need for an exact correspondence between the proportions of proteid, fat, and sugar, in milk modifications with what is found in human milk. This change of opinion has arisen largely through its having been realised that milk is naturally of variable composition.

The importance of securing a milk which is free from bacterial contamination is as strongly held as ever, and while all admit the superiority of fresh over cooked milk, it is at present practically impossible to secure sterility except by some process of heating. Boiling, pasteurisation at 156° F. for 20 minutes, and sterilisation in a water-bath at 212° F. for periods of from 5 minutes to 45 minutes, all have their advocates; the first and the last are perhaps the most widely used, as being free from the uncertainty of pasteurisation. "Buddised" milk—*i.e.* milk which has had added to it as much hydrogen peroxide as it will decompose when subjected to a temperature of 120° F. for 3 hours—has been introduced by Dr. Budde; it is stated that milk so heated remains sterile, and does not present the disadvantages of boiled milk. This milk is now on its trial, and it is very doubtful whether it will really prove superior or even equal to ordinary boiled or sterilised milk.

The work of the Royal Commission on Tuberculosis (see TUBERCULOSIS) has drawn renewed attention to the conveyance of the contagion of tuberculosis by milk. In the opinion of the commissioners the danger of such transmission does exist. Some clinicians believe that abdominal tuberculosis is frequently caused by infected milk; others believe that the risk is very small. In any case, the disadvantages of the use of milk sterilised by heat are so trifling in comparison with even the remote possibility of infection with tuberculosis, that it is unjustifiable to feed young infants with raw milk unless one is assured that it is derived from cattle which have passed the tuberculin test.



In random samples of commercial milk the percentage which contain living tubercle bacilli is considerable—7·8 per cent. in Manchester (1901-1906); 13·05 per cent. in Sheffield (1902-1906); 1·5 per cent. in Liverpool town milk, and 6·5 per cent. in Liverpool country milk (1906-1907).

*Thermal Death-Point of Tubercle Bacilli in Milk.*—Boiling kills the organism. It may survive exposure to 158° F. for half an hour, especially if a pellicle is allowed to form on the milk, in the meshes of which the bacilli become entangled. Russell and Hastings found that a temperature of 140° F. maintained for 20 minutes ensured their destruction, provided the milk was in a closed vessel and that no pellicle was allowed to form.

*Feeding with Undiluted Milk.*—This, which is more commonly known as “Budin’s Method,” has attracted considerable attention since the appearance of the late Professor Budin’s work, *Le Nourrison* (English translation by Maloney, *The Nursling*, (London) 1907). The feature of the method is the use of cow’s milk, undiluted and unmodified in any way except by the process of sterilisation. In Budin’s hands it was extraordinarily successful, and although others have not been so fortunate in their experience, it is probable that some of the failures have been due to neglect of the details on which Budin insisted. Budin’s method is only suitable for healthy infants. In most cases Professor Budin was able to supervise the feeding of his cases from birth onwards, and thus was dealing with a class of patients different from those attending dispensaries and hospitals in this country, most of whom already suffer from digestive disorder at the time they come under treatment. Another point which is sometimes overlooked is that Budin himself advised that the milk should be diluted with water in the case of premature, weakly infants. Overfeeding is the most fertile source of difficulty in Budin’s method, and in adopting this method of feeding the following rules must be adhered to:—

1. The milk must be sterilised at 212° F. for 45 minutes in a Soxhlet’s or similar steriliser. After the first few months the period is shortened, and when the infant is 8 or 9 months old 5 to 10 minutes is ample.

2. The quantities given must be small. On an average a quantity of milk equal to one-seventh of the body weight is given daily—to a baby weighing 7 lbs. 15 ozs. As a general rule it is best to begin at birth with 10 feeds of 1 oz. each.

3. The amount of food required is judged of solely by the weight curve. So long as the baby gains 4 or 5 ozs. every week the daily ration should not be altered. If the weight be stationary, or fall, 2 or 3 ozs. of milk should be added to each day’s feeds.

The advantages of Budin’s method are (1) simplicity; (2) economy; (3) normal development and absence of rickets. There is no special liability to scorbutus. The dyspepsia which is said to occur after a month or two is almost certainly due to overfeeding, and can be avoided. The chief disadvantage is the cost of the steriliser. In all probability one of the chief reasons why babies tolerate sterilised undiluted milk so well is that the prolonged heating precipitates the lime salts, and diminishes the amount of curd formed.

*The Use of Sodium Citrate.*—In 1893 A. E. Wright pointed out that the addition of sodium citrate to milk prevented curd formation, and in 1904 Poynton drew attention to the application of this property



to infant feeding. Since his paper appeared citrated milk has been much used, and is generally recognised as of the greatest value in many cases. Sodium citrate often relieves the digestive disorder—colic, flatulence, and the passage of green mucous stools containing “curd”—which ordinary diluted milk causes; it also enables a baby to take a stronger milk mixture than would otherwise be possible. *In vitro* 1 gr. of sodium citrate to 1 oz. of milk greatly diminishes, and 2 grs. abolishes, curdling on the addition of rennin and 5 drops 1 per cent. HCl. The action is believed to be due to the precipitation of the soluble calcium salts of the plasma, or to their conversion into a non-ionisable form. Sodium citrated should be prescribed in a solution (grs. viii.-grs. xvi. ad  $\zeta$ i.), to each 4 ozs. of which a drop of chloroform is added to prevent the growth of moulds. A teaspoonful is added to each ounce of milk given. In bad cases 2 grs., in mild ones  $\frac{1}{2}$  a grain, may be added; the amount of citrate should be gradually diminished as the patient improves.

*Buttermilk*.—Buttermilk has been used in Holland as a food for infants since the eighteenth century, and latterly its use has extended to other countries. It is most valuable in many forms of chronic gastrointestinal disorder, particularly when there is excess of fat, or “curd” in the stools. (The whitish masses of so-called “curd” which are often seen in the motions of infants suffering from diarrhoea are in reality soaps. They are not evidence of difficulty in digesting casein, but rather prove that the food as a whole, particularly the fat, is disagreeing.) Contrary to what might be anticipated, there is seldom any difficulty in persuading infants to drink buttermilk. Only buttermilk which is not more than twenty-four hours old should be used, and the difficulty of obtaining a regular daily supply is one of the few drawbacks to its employment.

Buttermilk has the following average composition:—

Proteid, 2·6 per cent.; fat, ·6 per cent.; sugar, 3 per cent.

It contains about ·7 per cent. of lactic acid, and swarms with lactic acid bacteria. Buttermilk requires preparation before being used as a food for an infant. One ounce of cane-sugar is dissolved in thirty ounces of buttermilk; four or five ounces of the sweetened milk are stirred into a cream with half an ounce of flour, and the rest of the milk is added. The whole is then boiled, and during the time it is on the fire it must be constantly stirred to prevent the formation of a gritty curd. The last point is absolutely essential, or the mixture will be spoiled. It is then given in the usual quantities and at the usual intervals.

Buttermilk differs from fresh milk in these respects:—(1) Its proteid and sugar are low, and it is almost devoid of fat. (2) Its casein exists in the form of casein lactate, on which rennin has no action. (3) It is strongly acid. (4) It contains many lactic acid bacteria. An explanation of its usefulness has been sought in each of these peculiarities. It is not well borne when given raw, and it seems to act as well when it is alkalinised as when it is acid, hence the two last-named peculiarities do not come into question. It probably owes its value to the absence of coagulable casein and to its poverty in fat. Czerny and Keller regard it (when prepared for use as above) simply as a cereal food, and think its proper sphere of usefulness is in cases of malnutrition from cow's milk (*Milchnährschaden*).

Buttermilk may be tried with fair prospect of success in any form of subacute or chronic gastro-intestinal disorder, or in the convalescence



from acute diarrhœa. As the stools improve, in the course of a few weeks, ordinary milk should be substituted first, little by little. It is necessary to make the change gradually.

**Infantile Atrophy.**—To the account of the symptoms of infantile atrophy from the pen of the late Dr. Henry Ashby in the *Encyclopædia Medica* (Vol. I. p. 405), there is nothing to add, and his discussion of the general causation of the disease requires little amplification. The pathology of atrophy was unsettled when he wrote his paper; it is still far from being definite. Nevertheless some important work has been done on the subject by Czerny, Keller, and others, chiefly of the Breslau school. It is admitted that the anatomical changes described by Baginsky (atrophy of the gastro-intestinal mucous membrane) do not adequately explain the disease, and that bacteriology has also failed to demonstrate any clear connexion between bacterial infection of milk and atrophy. Czerny and Keller attach considerable importance to cow's milk in the production of marasmus. They group disturbances of nutrition under three main heads:—Disturbances from alimentation, disturbances from infection, and disturbances from constitutional defect. Looking at the subject from this point of view, atrophy is merely the ultimate result of one of these causes; we discard such description of clinical phenomena as "follicular enteritis," "acute diarrhœa," "gastro-enteritis," "cholera infantum," etc., because a patient may show signs of one of these at one time, of another later, and because any one of them may result from each of the above sets of causes. The general idea is to group together under one general rubric, "nutritional disturbances," all the various clinical types of gastro-intestinal disorder which ultimately tend to produce atrophy, and to try to trace exactly the different causes which lead to this.

The most important form of nutritional disturbance is that described by Czerny and Keller as "milk injury" (*Milchnährschaden*). The child, dieted on cow's milk, becomes restless, his sleep is disturbed, his motions become greyish instead of yellow and are dry and crumbly; he becomes pale, wasted, his belly is blown out with gas. Ultimately the picture of extreme atrophy develops, complicated by intractable diarrhœa, and by infections of all kinds. According to Czerny and Keller this condition may arise even when the quality of the milk is beyond reproach, and when all attention is paid to its sterility. It depends on some chemical peculiarity of cow's milk. Czerny and Keller deny that the casein plays any part. They think that there is no evidence that this is less digestible than that of human milk. The masses of so-called "curd" in the stools do not consist of undigested casein, but of soaps. Neither will Czerny and Keller admit that undigested casein is specially prone to undergo abnormal decomposition in the intestine and thus prove deleterious. If the fæces of such cases are examined they are found to contain quantities of the soaps of fatty acids, and it is found that the child's nutrition improves when the amount of fat in the food is restricted, and is replaced by carbohydrate.

This is one of the chief results of Czerny and Keller's work. When an infant, hitherto fed on cow's milk, often in excessive quantity, begins to manifest the above symptoms and to lose weight, the indication is, not (as is usually done) to increase the daily ration or to render the casein more digestible, but to cut down the fats and add some starch. In mild cases it is sufficient to reduce the amount of cow's milk con-



siderably, and to substitute for what is withdrawn a cereal decoction—*e.g.* oatflour gruel. In bad cases milk should be withdrawn altogether for a time, and a purely cereal diet given. The substitute which Keller especially recommends is a malt extract prepared according to a method he has devised. This is sold under the name of *Loefflund's Malz-Suppe Extrakt*. It is used in the following way:—Fifty grams of flour are beaten up with  $\frac{1}{3}$  litre of milk, and the mixture is strained. One hundred grams of Loefflund's malt extract are dissolved in  $\frac{2}{3}$  litre of warm water, and this is added to the milk and flour. The whole is heated to boiling point, with continuous stirring. This is given in the ordinary quantities. Keller believes that buttermilk, as ordinarily prepared for an infant (see INFANT FEEDING), is useful simply as a food poor in fat and rich in cereal.

The diagnosis of "milk injury" as a cause of marasmus depends largely on the history. In regard to prognosis, auscultation of the heart is important. "As long as both sounds are clearly heard, even when the child is restless, life is not in immediate danger. As soon as the sounds become difficult to hear, and cease to be clearly defined, or if the first sound is fainter than the second, the infant is dangerously ill, even although from its general appearance it may appear to be doing well."

The present writer's opinion is that marasmus of this kind is not nearly so common in this country as it seems to be among Czerny and Keller's cases. Undoubtedly, however, cases of the kind do occur, and the adoption of the line of treatment suggested—diminution of the quantity of milk, and the substitution of a cereal decoction or a malted food, or a buttermilk mixture—sometimes proves extremely satisfactory.

**METABOLISM IN INFANTILE ATROPHY.**—Even when there is great failure of nutrition, nitrogen is well absorbed from the intestine. What is more remarkable is that along with a progressive loss of weight there is usually a positive nitrogen balance—*i.e.* intake of N exceeds output. This assimilation of protein, despite a falling body weight, is referable to the fact that though the body is losing weight it is building up new cells; Camerer has observed that even weakly wasted children grow in height. These facts go in the direction of showing that we cannot base a theory of marasmus on faults in the proteid element of the food.

The ill effects of an excessively fatty diet are supposed to be connected with ACIDOSIS (*q.v.*). Acidosis may be relative (decrease of alkali in the tissues), or absolute (increase of acid); in either case it is measured by the amount of ammonia-nitrogen in the urine. When acids are formed in the tissues or absorbed from the intestine, absolute acidosis results; when acids, still in the intestine, are neutralised there by alkalies withdrawn from the tissues for the purpose, there is relative acidosis. Keller found that in children gastro-intestinal disturbances and marasmus were associated with increased ammonia-nitrogen in the urine; he ascribes this to an increased excretion of fixed alkali by the intestine. "The primary event is the excretion of fixed alkali by the intestine, brought about by the fat taken as food. The alkalies are got rid of either unchanged or as soaps, but besides this they also serve to neutralise the increased phosphoric acid, the cause of which is the simultaneous increase in the amount of calcium phosphate combining with fat to form a calcium soap. The importance of relative acidosis in chronic disturbances of nutrition in infants lies in the loss of alkali.



For the growth and health of the child's organism the retention of alkali is as important as the retention of nitrogen, phosphorus, or other mineral substances. If it is withheld or a loss takes place, the condition of the body can neither improve nor remain normal. Under these circumstances, owing to the endeavour of the body to keep its relative composition unchanged, failure of increase in weight, or loss of tissue substance occurs; and since growth in height can take place even when the body weight is not increasing, or is actually decreasing, eventually the case presents the clinical features of an atrophy which is alimentary in origin." (Czerny and Steinitz.) (Compare also Herter's work on Infantilism, *infra*.)

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THE THYMUS AND THYROID GLANDS IN MARASMUS.—The thymus gland is atrophied in cases of marasmus, but there is no evidence that marasmus is due to interference with the function of the organ. Stokes regards the condition of thymus merely as an index of the general nutrition; the state of nutrition of an infant may be estimated by a microscopic examination of the thymus at autopsy. No benefit is obtained by treating marasmus with thymus. Maclellan found that after extirpation of the thymus animals were more vigorous and voracious than the controls, and put on weight more quickly. Others have seen no action on growth from removal of the organ. No experimenter has ever stated that thymectomy causes atrophy.

Some important observations by J. W. Simpson must be referred to, because they mark a definite advance in the treatment of marasmus. In examining the thyroid in ten cases of marasmus, he found that many of the vesicles were devoid of colloid, that some showed cell-proliferation, and that the fibrous tissue, particularly the intra-vesicular fibrous tissue, was increased. This led him to try the effect of treating marasmus with thyroid, and in some instances the results were most striking. The drug was given in doses of  $\frac{1}{3}$ - $\frac{1}{2}$  gr. of B. & W. tabloids thrice daily. No other change in the treatment was made. Thyroid treatment should be tried in all cases of marasmus; sometimes it acts remarkably well, in others it fails absolutely, but as the remedy is harmless, and often brilliantly successful, it ought certainly to be administered to all atrophic babies.

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**Infantilism.**—The term infantilism should be restricted to a group of cases which have as their common and most important feature a failure of the primary and secondary sexual characters to appear at their proper time. Dr. John Thomson, who emphasises this point, divides cases of infantilism into three groups:—(1) Idiopathic infantilism. (2) Cachectic infantilism. (3) Infantilism due to gross lesion or defect of some important internal organ. The condition is therefore merely a symptom, or symptom-complex, which may be due to more than one cause. It is usually associated with stunted growth, but not necessarily so. The essential characteristic is the persistence of sexual immaturity, and this may go along with normal growth, or even giantism, as well



as with dwarfing. A case of combined giantism, acromegaly and infantilism has been reported by Launois and Pierre Roy. Their patient was a giant, the primary and secondary sexual characters were undeveloped, the epiphyseal cartilages were persistent, and there was enlargement of the lower jaw. Pagniez states that a case of this kind may pass through three stages: infantilism, with persistence of the epiphyseal cartilages; rapid growth, producing a giant; cessation of growth, fusion of the epiphyses, and the development of the signs of acromegaly. Conversely, dwarfs are not necessarily infantile; many of them—*e.g.* cases of sexual ateleiosis (Hastings Guilford), of which General Tom Thumb was an instance—show normal sexual development.

(1) Idiopathic infantilism. This group of cases comprises what is known as the Type Lorain (after the French physician who first drew attention to them) or anangioplastic infantilism, because they are supposed to be due to vascular hyperplasia. Patients of the type Lorain are small in stature, but have to some extent lost their childish proportions. They have the frames of adults in miniature, or, perhaps more correctly, the frames of miniature adolescents. The bones are small and slender; the genital organs are undeveloped, and the mental powers childish.

(2) Cachectic infantilism. The principal diseases which give rise to cachectic infantilism are Pott's curvature of the spine, tuberculosis, syphilis, biliary cirrhosis, and cardiac affections. Some (*e.g.* Gilbert and Rathery) would class these cases along with the preceding. It is, of course, a matter of daily observation that children with heart disease, hunchbacks, and hereditary syphilitics suffer from retarded development.

(3) Infantilism from visceral defect or disease. This is the most interesting group. In it several varieties can be differentiated.

(a) *Thyroid infantilism*. This has been especially studied by Hertoghe. Persons suffering from infantilism due to thyroid inadequacy undergo an arrest of development proportional to the age at the onset of the malady, and they manifest more or less of the symptoms and appearances of mild myxœdema. Their faces are rounded, the eyes puffy, the nose is broad, the abdomen large, and the contour of the bones concealed by a thick layer of fat. The temperature tends to be subnormal; there is often constipation. The disposition is childish.

(b) *Pancreatic infantilism*. The first case of this kind was reported in 1902 by Dr. Byrom Bramwell. At the age of  $18\frac{9}{12}$  the patient had the stature and development of a child of 11; his intelligence was good. For 9 years he had suffered from chronic diarrhœa. The pancreatic secretion was shown to be absent (1) by the presence in the stools of undigested fat, which diminished on the administration of pancreatic extract; (2) by the low excretion of urinary phosphoric acid on a milk diet, the output being increased by the administration of pancreatic extract; (3) by giving Sahli's capsules of iodoform enclosed in a glutoid envelope, which is only dissolved by the pancreatic secretion. On treatment with pancreatic extract the diarrhœa ceased; growth, which had been in abeyance for 8 years, recommenced, and development of the primary and secondary sexual characters took place. Unfortunately treatment with pancreatic extract is not always successful in cases which to all appearance resemble that described by Dr. Bramwell. (c) *Intestinal infantilism*. This has recently been exhaustively studied by Herter. He describes as intestinal infantilism a class of case with the following characters:—arrest of bodily develop-



ment; maintenance of the mental power; marked abdominal distension; moderate anæmia; rapid onset of physical and mental fatigue; various digestive disturbances, especially fat-diarrhœa. The keynote of this form of infantilism is the persistence into later childhood of the intestinal flora which are normal in infancy. The faecal fields consist of Gram-positive organisms, instead of, as is normal, Gram-negative organisms. The urine gives evidence that abnormal intestinal putrefaction is taking place—high ethereal sulphates, indicanuria, indolaceturia, and excess of phenol. The calcium, magnesium, and phosphorus balances show a loss. In the fæces much fat is lost, which should normally be absorbed. Herter's explanation of the pathology of the condition is, briefly, as follows:—The retarded development is not due to an error of metabolism, but to defective digestion and absorption. The patients are intolerant of carbohydrates—the digestion is always disturbed when these are taken freely; they have little power of absorbing fat; their protein absorption is also rather bad. In consequence, nutrition is impaired, while, on account of the loss of calcium and magnesium the growth of the skeleton suffers. The malassimilation is due to chronic inflammatory processes in the small intestine and colon, brought about by the presence of an unsuitable flora, which also gives rise to abnormal putrefaction and toxæmia. The characteristic feature of the intestinal flora is the persistence of the infantile type.

*Treatment.*—The chief indications are dietetic. Carbohydrates should be given in small quantities, beginning with about 20 grams in the day; starches and dextrinised preparations (biscuits) are best. Sugars and soluble carbohydrates, such as malt and Mellin's food, are objectionable. Lactose is the best of the sugars. Potatoes are not well borne. Fats should be restricted until the stools no longer show any loss. Proteins.—Milk is the chief constituent of the diet; meat should be sparingly and cautiously used. Gelatin ought to be added to the diet. About 1 oz. per day can be absorbed. Gelatin has some caloric value (120 cal. per oz.); it is a partial substitute for protein fat and carbohydrate; it is unable to support certain forms of bacterial life associated with this disease; it is incapable of undergoing putrefaction based on the presence of the tyrosin molecule. Calcium lactate, magnesium lactate, and acid sodium phosphate should be given.

In any case of infantilism a radiograph of the carpus should be taken; if the epiphyseal cartilages have disappeared, growth is probably impossible; if they persist it may occur. Thyroid ought to be tried in all cases, even if there are no signs of thyroid inadequacy.

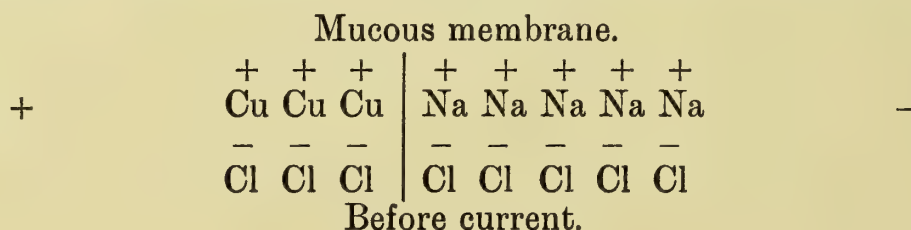
**LITERATURE.**—JOHN THOMSON. Art. "Infantilism," in CLIFFORD ALLBUTT and ROLLESTON'S *System of Medicine*, 2nd ed., vol. iv. pt. i. (London), 1908 (with reference).—BYROM BRAMWELL. *Scott. Med. and Surg. Journ.*, April 1904.—GILBERT and RATHERY. *Arch. gén. de méd.* (Paris), 1st March 1904.—LAUNOIS. *Nouvelle Iconographie de la Salpêtrière*, 1902.—PAGNIEZ. *Presse méd.* (Paris), 12th Dec. 1903.—HASTINGS GUILFORD. *Brit. Med. Journ.*, 8th Oct. 1904.—C. A. HERTER. *Infantilism from Chronic Intestinal Infection* (Macmillan Co., New York), 1908.

**Ionic Medication in Gynecology.**—There are certain gynecological diseases of an obstinate nature, such as chronic cervicitis, chronic endometritis, and membranous dysmenorrhœa, for the relief of which the medical man is poorly supplied. He is recommended by the current text-books to try the effect of douches, of plugs, of caustics, and of curettage; but he often finds little permanent benefit to accrue from such means, even if used for considerable periods of time. Dr. Samuel

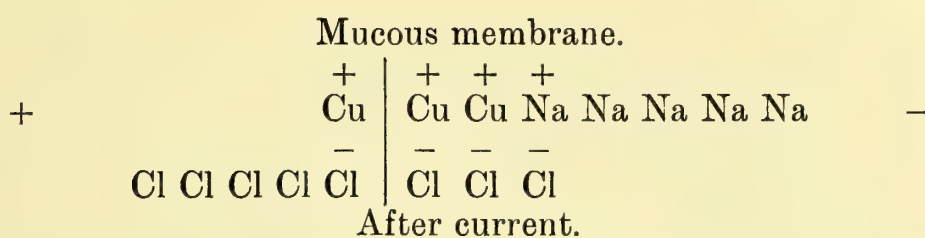


Sloan suggests that he try the employment of ionic medication, and encourages him by a record of cases in which this new therapeutic agent has been most beneficial.

To quote from Dr. Sloan's article (*Proc. Roy. Soc. Med.*, June 1908), "Ionic medication is the application of electro-chemistry to therapeutics. To students of recent advances in physical chemistry, chemical affinity comes simply to mean electric attraction and electric repulsion of the atoms or molecules in solution. These atoms or molecules have each a charge of electricity, some of them being positive and some negative. Being electrically charged and capable of moving in virtue of this charge, they are called ions or movers. Let an electric current be passed through such a solution, and at once, from a restless state of activity, the ions proceed to arrange themselves so that the  $-$ ions may move towards the  $+$  pole and the  $+$  ions towards the  $-$  pole; like charges repelling and unlike attracting. The ions moving towards the  $+$  pole are called anions, that is anode-goers; those towards the  $-$  pole kathions, that is kathode-goers. Hydrogen and all metals are kathions; iodine, chlorine, etc., are anions. In the case of compounds the bases are kathions and the acids are anions. Thus, in the case of a solution of sulphate of copper, the sulphuric acid, being an anion, will drift towards the  $+$  pole; whilst the copper will move towards the  $-$  pole. Any solution capable of conducting a current of electricity through it is called an electrolyte; and the passage of the current brings about decomposition of the electrolyte. The motions of the ions constitute the current, each atom carrying with it an equal quantity of electricity. The human body is an electrolyte in virtue of the salines of its tissues. The principal saline being NaCl, the body acts electrically as a solution of chloride of sodium." These ionic movements can, therefore, be produced in the human body, and their production can be regulated and employed for therapeutic purposes. When the changes are at the poles only, electrolysis results; and electrolysis, as is well known, has proved of some service in the treatment of fibroid tumours of the uterus: the nascent oxygen and acids of the tissue electrolyte which are set free at the  $+$  pole have a caustic or an antiseptic effect, whilst at the  $-$  pole (when it is made the active one) the sodium hydroxide which is liberated has a softening and solvent effect on the tissues. In the case of fibroid tumours the  $+$  pole is usually made the active and intra-uterine one. Dr. Sloan, however, does not recommend simple electrolysis, but what is called ionic migration. In this phenomenon there is a further "transfer of the ions of the applied solution or soluble electrode from one pole in the direction of the other, of zinc or copper, as the case may be, from the  $+$  pole, and of iodine, sulphuric acid, or salicylic acid, as the case may be, from the  $-$  pole." A solution of cupric chloride is placed on one side of a mucous membrane (*e.g.* that of the vagina or uterus), whilst on the other side is the chloride of sodium of the tissues; an electric current is now passed, with the result that there is an actual transference of ions. The result can be expressed by means of Dr. Sloan's diagram, the copper being applied at the  $+$  pole—







This ionic medication has been employed in cases of chronic cervicitis with very good results; "the discharge, from having been muco-purulent and copious, has become milky and of small amount, whilst the gaping os has become normal in size, with the everted mucous membrane drawn in, and erosions have rapidly healed. Improvement in the general health has followed the amelioration of the local septic condition. In a case of membranous dysmenorrhœa the amount of membrane has gradually decreased until none has been found. In uterine hæmorrhage and in bacteruria ionic medication has proved beneficial." A glass speculum is used and a 1 per cent. solution of cupric chloride; the cervical and intra-uterine electrodes (spirals of copper wire) are inserted through the speculum, the neutral electrode (a large clay one) being applied to the hypogastrium or sacral region, or preferably to the hands (no rings being worn). A special vulvo-vaginal electrode has been contrived by Sloan and described by him in the present year (*Proc. Roy. Soc. Med.*, May 1909); it allows the physician to apply at one and the same time the ionic solution to the whole of the genital surface from the vulva to the orifices of the Fallopian tubes. The current is got from a battery of from fifteen to twenty Leclanché cells of good size; a rheostat is needed to regulate the current and a galvanometer to register the quantity used. An average dose is 15 ma. for 15 or 20 minutes. In subacute cases Sloan prefers to begin with iodine instead of copper as the ionic agent; then the negative pole is made the active one and the electrode is of carbon; and the solution is a 2 per cent. one of iodide of potassium, combined with .2 per cent. solution of liquor iodi. In some of Dr. Sloan's earlier cases considerable pain, and, in some cases, some pelvic cellulitis followed the ionic medication; but he thinks these results can be, with care, eliminated. It will be interesting to find whether this novel plan of treatment helps the gynecologist to overcome the exceedingly troublesome cases of chronic cervicitis and endometritis of a septic nature for which it has been proposed.

**Ionisation in Skin Diseases.**—The treatment of skin diseases by electrolysis with zinc and other metals is quite a recent one. Leduc was the first to try it, in 1903, and since then Lewis Jones and others have worked at the subject. For the treatment are required an ordinary continuous current battery with a galvanometer, connecting wires, a flat pad on the negative pole, and a zinc electrode at the positive pole. The zinc is covered with several layers of lint, and is dipped in a 2 per cent. solution of zinc sulphate in distilled water. The negative pole, with the pad electrode, is applied to any convenient part of the patient, and the zinc electrode, moistened with the zinc sulphate solution, is placed on the diseased area, and a current of from 5 to 10 milliampères allowed to pass for about 10 minutes. In a solution of zinc sulphate ( $\text{ZnSO}_4$ ) the salt is partly divided up into zinc atoms, which carry a positive charge of electricity, and  $\text{SO}_4$  atoms, which carry a negative charge of electricity. When the current is passed, the zinc ions move from the positive towards the negative pole, and the  $\text{SO}_4$  ions in the



opposite direction. Therefore, when the current is turned on, the zinc ions immediately start to move towards the negative pole, and are thus carried into the tissues and deposited there. The difference between this method of introducing a drug and the hypodermic injection is that by electrolysis the zinc is introduced into the actual lymph-spaces and protoplasm of the cells.

**RODENT ULCER.**—Rodent ulcer is the disease in which the best results have been obtained by this method. After one application a small rodent disappears in about three weeks. If any disease is left, the treatment may be repeated in a month. Rodents of considerable size have been reported as cured by this method. The great disadvantage of the method is the pain, which is very considerable, and although the application of cocaine is said to prevent that, unfortunately it does not always do so.

Various drugs may be applied similarly to the zinc sulphate. It must be remembered that the correct electrode must be used with each drug. Alkalies, alkaloids, and metals are used with the positive pole, whilst acids, chlorine, bromine, and iodine come off at the negative pole.

**RINGWORM.**—It has been attempted to introduce copper and salicylate of soda ions for the cure of ringworm of the scalp, but as individual hairs are apt to escape, the results so far have not been encouraging.

**WARTS.**—Warts may be cured by the application of magnesium ions.

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**Jaundice.** CONGENITAL FAMILY CHOLÆMIA; CHRONIC ACHOLURIC JAUNDICE.—Attention may be called to a rare form of chronic jaundice, which has been the subject of several recent papers. Its leading characteristics are its chronicity, its tendency to affect several generations or members of a family, the absence of bile pigment from the urine (whence the name "acholuric jaundice"), and the association with it of blood changes suggestive of pernicious anæmia, and chronic splenic enlargement.

Hawkins and Dudgeon state that—"It is certain (1) that a child may be born jaundiced or may become jaundiced soon after birth; (2) that the jaundice may persist with little or no variation for many years, at any rate till middle life; (3) that the spleen in these cases is always enlarged; (4) that there is considerable anæmia, with a low colour-index, poikilocytosis, and the presence of nucleated red cells; (5) that nevertheless the patient has good or fair health, can stand intercurrent diseases; and, if a woman, is able to bear children; (6) that bile pigment is present in the stools as in health, that it is not present in the urine, but that any darkening of the urine which may be present is due to urobilin; (7) that nevertheless bile pigment is present in the serum; (8) that this condition tends to appear in more than one member of a family, and in successive generations."

The sexes seem to be equally affected; in some cases at least the jaundice is congenital. The disease does not necessarily shorten life. The jaundice attains about the same degree as ordinary catarrhal



jaundice, and is unattended by gastric disturbance, itching of the skin, or clubbing of the fingers. The disease is not due to syphilis or alcoholism. The enlargement of the spleen is comparatively moderate; its lower end may reach the level of the umbilicus, but this is the outside limit. Enlargement of the liver is less marked, and there is no evidence of cirrhosis. All observers have found changes in the blood, and as these are of importance in relation to the nature of the disease, Hawkins and Dudgeon's report on their four cases may be quoted in full: "Red cells vary from 2,590,000 to 3,676,000, the average being 3,090,000, rouleaux formation is poor or absent, microcytes are numerous, polychromatophilia is marked, poikilocytosis is well marked; granular degeneration was well marked in one case. In these four cases respectively, 1 megaloblast, 7 normoblasts and 27 megaloblasts, 15 normoblasts and 10 megaloblasts; 5 normoblasts and 1 megaloblast were seen in counting 500 leucocytes. In two cases 'ghosts' were very numerous. The hæmoglobin varies from 35 to 70 per cent., the average being 44 per cent.; the colour-index varies from .58 to .9, the average being .69. Fibrin formation was absent in one case, slight in another; blood platelets were very numerous in one case, scanty in another. The leucocytes vary from 3800 to 6120, the average being 4880, with no real alteration in relative proportions, though there was slight excess of polynuclear neutrophiles in one case (adult) and slight lymphocytosis in another (aged 7). In three cases the serum was strongly tinged with demonstrable bile pigment." In the cases reported by Hutchison and Panton similar changes were found, with, in addition, the presence of a few neutrophile myelocytes. In the series of cases described by Buchan and Comrie under the name "congenital anæmia with jaundice and enlargement of the spleen" the blood changes were more profound, nucleated reds, abnormal mitoses, and a fair proportion of myelocytes being present.

Though the disease is perhaps best described as "family acholuric jaundice," isolated cases, without hereditary antecedents, and cases associated with bile pigment in the urine have been reported. In a very remarkable series of cases placed on record by Buchan and Comrie, which apparently come into this category, four successive infants in one family were affected. The first-born child (male) was in all respects normal. The second (male) was jaundiced at birth, developed splenic enlargement and marked changes in the blood within the first few weeks, and then made an absolute recovery by the time he was nine months old. The third child (female) had jaundice, splenic enlargement, and anæmia from birth, and died when two days old. The fourth child (female) also suffered from jaundice and anæmia, and died when a week old. The leading features of Buchan and Comrie's cases were—(1) Profound anæmia. (2) Active hæmopoiesis leading to the appearance in the blood of large numbers of premature or foetal types of cell. The active hæmopoiesis was taking place in the bone marrow, and also to an abnormally marked degree in the liver. (3) Destruction of the red cells was going on, as was evidenced by the presence of phagocytes containing blood pigment in the spleen, and phagocytes engulfing red cells in the circulating blood. (4) Obstructive jaundice was present, as evidenced by distension of the biliary canaliculi.

There are two main hypotheses as to the nature of acholuric jaundice with anæmia. (1) On the one hand the jaundice may be primary, due perhaps to defective development of the larger biliary passages, with



consequent absorption of the bile by the hepatic lymphatics, and splenic enlargement and blood changes secondary to the cholæmia so produced. (2) On the other hand the anæmia may be the cause of the jaundice. In this event we have a primary hæmolysis, producing anæmia, and causing hæmolytic jaundice. The second hypothesis is that which has most in its favour. There is no proof that the serum in these cases is endowed with abnormal hæmolytic power, but there is some evidence that the red corpuscles are abnormally fragile. Both Hawkins and Dudgeon, and Hutchison and Panton found that lysis of the cells occurred in a solution of sodium chloride up to .6 per cent., whereas normal corpuscles are not lysed except by solutions weaker than .4 per cent. Hawkins and Dudgeon also found that the serum of their cases contained hæmagglutinins.

As regards the treatment of the condition, the only point worth noting is that, unlike pernicious anæmia and splenic anæmia, it shows no improvement under arsenic.

LITERATURE. — Several of the following papers contain fairly complete bibliographies:—HAWKINS and DUDGEON. *Quarterly Journ. of Med.*, Jan. 1909.—HUTCHISON and PANTON. *Ibid.*, July 1909.—BUCHAN and MACGIBBON. *Scott. Med. and Surg. Journ.*, Sept. 1906.—BUCHAN and COMRIE. *Journ. Path. and Bact.*, xiii. p. 398, 1909.—BENJAMIN and SLUKA. *Berl. klin. Wochens.*, 26th Aug. 1907.—CLAUS and KALBERLAH. *Ibid.*, 12th Nov. 1906.—STRAUSS. *Ibid.*, 10th Dec. 1906.

**Kala-Azar.** (See *Encyclopædia Medica*, Vol. XII. p. 396). —ETIOLOGY.—The parasite which is now known to cause kala-azar was first demonstrated in 1903 by Leishman in *post-mortem* smear preparations from the spleen of a soldier who died in London from chronic fever contracted in Dum-Dum (“Dum-Dum fever”). Leishman regarded the new organism as a degenerated form of trypanosome. As soon as Leishman’s paper reached India Donovan realised that he had already observed the same organism in the spleens of patients dying from prolonged fever in Madras. He, however, denied that the parasite was a trypanosome, and Laveran, to whom specimens had been sent, formed the opinion that it was a piroplasma. In the same year, Wright discovered structures resembling these “Leishman-Donovan bodies” in the tissues of the Delhi boil, and it was at first thought that the two were identical. It is now believed, however, that the parasite found by Wright is not, in fact, the same as that of Leishman and Donovan. An important step was taken when Rogers, and subsequently James, showed that the Leishman-Donovan bodies were constantly present in the spleen in cases of kala-azar. The observation has been so thoroughly confirmed that it is now certain that they are the cause of the disease. (See PROTOZOA.)

As originally described by Leishman, the organism is a small, round or oval structure, from 2 to 3  $\mu$  in diameter, containing two masses of chromatin, one large and circular, the other smaller and rod-shaped—the macronucleus and micronucleus respectively. These stain deep red with Romanowsky, and are embedded in a faintly blue-staining cytoplasm. The organism is found either singly or in clumps of from 20 to 50. It is found in every organ of the body, but is most numerous in the spleen, bone marrow, and liver. In the circulating blood it is scanty, especially during the early stage of the disease; but in the later stages it is possible to demonstrate its presence in more than 75 per cent. of cases. The organism exists chiefly in the large endothelial



cells of the spleen and marrow; it multiplies in these by division until the invaded cell bulges and ruptures into a vessel. In the blood the parasite is found in the polynuclear leucocytes, but not, apparently, in the red corpuscles—an important point in connection with its supposed relationship to the piroplasma. The further development of the parasite has been elucidated by Rogers. He found that by incubating blood containing the parasite at low temperatures ( $22^{\circ}$  C.) rapid multiplication took place, the organism meanwhile developing a blue-staining cytoplasm, and then acquiring flagella and the power of active movement. At this stage the parasite was elongated instead of round or oval, and its flagella arose from the region of the micronucleus. Multiplication of the flagellar forms is effected by a process of division, beginning with the micronucleus and flagellum, and extending to the macronucleus and protoplasm. This process of division is repeated until a rosette-shaped mass of organisms is formed, the flagella being centrally, the bodies radially placed. Ultimately the actively mobile organisms break away from the rosette, undergo regressive changes, and are found (*in vitro*) in the polynuclear leucocytes as the original oval Leishman-Donovan bodies.

From the absence of any appearance of an undulating membrane, Rogers denies that the organism is a trypanosome, while the presence of a flagellum separates it from the piroplasma. He looks on it as allied to the hepatomonas. An essential factor for successful cultivation outside the body is that the temperature be low. The optimum is from  $20^{\circ}$  to  $22^{\circ}$  C.; above  $25^{\circ}$  C. there is no marked development. Bacterial contamination is fatal to its growth. Under anærobic conditions, though the organism does not die, its development does not occur. Rogers found that development was much favoured by rendering the blood slightly acid by citric acid, and from this hint he was led to suspect the bed bug (the tissue juices of which are also faintly acid) as a carrier of infection. In 1906 Dr. Patton detected the parasite in the stomachs of bugs which had fed on kala-azar patients, but not in mosquitoes; he subsequently traced their development in the bug up to the flagellar stage.

Leishman's discovery of the new pathogenic organism has not only placed the pathology of kala-azar on a sound basis, but has done a great deal towards clearing up the nature of the chronic fevers of Bengal. Since the Leishman-Donovan bodies have become known, cases of the disease have been reported in districts of India where kala-azar is not epidemic, as well as from Penang, Hankow, Tunis, the Egyptian Soudan, and Manila. The distribution of the disease is thus far wider than has hitherto been supposed.

The parasite can only be demonstrated in the blood after prolonged search, especially towards the commencement of the disease. It is much more readily found in smears of fluid withdrawn by splenic puncture, but this proceeding is not free from risk, and Rogers condemns it in patients who are markedly anæmic, or who have recently suffered from any kind of hæmorrhage. Apart from the detection of the parasite, however, the examination of the blood is of diagnostic importance, for in kala-azar leucopenia is a striking symptom. The leucocytes may fall to 1000 or even 500 per c.mm., and so low a count as this is almost diagnostic.

Unfortunately the treatment of the disease has made no such strides as our knowledge of its pathology. The mortality comes within sight of 100 per cent. Rogers advises the persistent, patient use of large



doses of quinine; he gives 60 grs. a day until the temperature falls, and then continues with smaller doses for many months. Under this treatment it is said that recovery takes place in a larger percentage of cases than by any other method.

LITERATURE. — LEISHMAN. *Brit. Med. Journ.*, 30th May 1903; 26th Feb. 1904.—DONOVAN. *Ibid.*, 11th July 1903.—ROSS. *Ibid.*, 14th Nov. 1903.—MANSON and Low. *Ibid.*, 23rd Jan. 1904.—ROGER. *Ibid.*, 28th May 1904.—Milroy Lectures, *ibid.*, 23rd Feb., 2nd March, and 9th March 1907.—NICOLLE and CASSUTO. *Presse méd.* (Paris), 8th Feb. 1908.—BENTLEY. *Indian Med. Gazette*, March 1904.

**Labour, Forceps in.**—Little requires to be said regarding the position of the forceps-operation in obstetric practice during the past quinquennium. The revival of symphysiotomy and pubiotomy has tended to narrow the sphere of the forceps, whilst, on the other hand, the neglect of version has had the effect of slightly broadening it. There seems to be a growing feeling against the use of the instrument in high cases, especially in contracted pelves; and it is only too true that such an application of the forceps is sometimes simply a craniotomy in disguise, an embryulcia under a wrong name. On the other hand, it would seem, from some discussions which have taken place on the subject, that the use of forceps in cases of simple delay in labour, without marked pelvic contraction, is increasingly frequent. Thus in a discussion on the use and abuse of midwifery forceps (*Trans. Edin. Obstet. Soc.*, xxix. p. 231 *et seq.*, 1904) in 1904, Drs. Dewar, Macvie, Somerville, Hamilton, and Spence all spoke strongly in favour of having frequent recourse to the forceps, and bore witness to the safety of such a practice and to the good results arising from it. Even under these circumstances, however, the late Dr. Horrocks and those who advocate his policy of non-interference in from 90 to 95 per cent. of all labours (*Brit. Med. Journ.*, i. for 1906, pp. 712, 713, 737, 773, etc., etc.) would forbid the employment of forceps; this may be described as an extreme opinion.

It is on the Continent, and especially in Germany and Austria, that the revolt against the routine use of forceps in contracted pelves has taken its origin and made its influence felt. Leisewitz (*Arch. f. Gynaek.*, lxxxi. p. 686, 1907), for instance, publishes statistics which must be described as startling. He states that between 1894 and 1907 there were 697 forceps extractions in the Dresden Lying-in Hospital; 63·13 per cent. were done to save the child, 14·2 per cent. to save the mother, and the rest for the sake of both mother and child; and that lesions due to the forceps were produced in 73·6 per cent. of the mothers and in 6·7 per cent. of the infants. He, therefore, thinks that the forceps in contracted pelves must be used with the greatest care and skill, that the high forceps operation is very dangerous, and that hebotomy or Cæsarean section ought to be performed in its place. He goes so far as to condemn absolutely the high forceps in the hands of the general practitioner, and recommends him to do hebotomy, or, when this cannot be done, perforation even of the living child (!). Leopold (*Arch. f. Gynaek.*, lxxxi. p. 731, 1907) holds somewhat similar views and uses the high forceps very seldom; in 81 per cent. of the patients with pelvic contraction spontaneous delivery occurred, and Weindler (*ibid.*, p. 718, 1907) also refers to this matter, stating that delivery without instrumental aid took place in pelves with a C.V. as small as 7 cm. It seems, therefore, as if the numerous cases of forceps delivery in this country (for pelvic contraction) were largely those



which were left to deliver themselves in Dresden. It must be noted, however, that, while the forceps is being less used in Germany, its place is being taken by such cutting operations as pubiotomy and Cæsarean section and not as a rule by the plan of waiting for natural expulsion. If we may judge from current obstetric literature, the present time is the operative era in midwifery.

With regard to the type of forceps in use, no great change in opinion or practice has to be recorded. The axis-traction principle of forceps-action is still that which is generally regarded as superior in theory; some obstetricians, however, would stop here, and argue that in practice it is unnecessary to use any other than forceps with a pelvic curve. The latter opinion is founded upon the fact that the chief advantage of axis-traction forceps is ease of extraction, and that it is only in exceptional cases that such a pair of forceps would succeed when the simple type has failed; but, surely, it is well to use by preference the instrument which gives the greatest amount of help in all cases. What may be called the spectre of the danger of the fixation-screw of axis-traction forceps was laid by Milne Murray in his letter to the *British Medical Journal* early in 1904, just before his lamented death. There still exists some difference of opinion as to the most suitable part of the forceps to which to attach the axis-traction rods. In Tarnier's forceps and in the British types (modelled upon Tarnier's) of Sir Alexander Simpson and the late Milne Murray, the rods are fixed just below the fenestræ of the blades; while in Neville's forceps and others their attachment is to the upper part of the handles near the lock. Theoretically the former is undoubtedly the more correct position; but possibly the greater ease of application and the simplification of the instrument found in the latter type may compensate for some loss of traction power and accuracy of direction, although Munro Kerr (*Operative Midwifery*, p. 336, 1908) does not think so.

## Labour, Induction of Premature.

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THE induction of premature labour, more especially for a medium degree of pelvic deformity, is perhaps the obstetric operation which more than any other deserves to be known as "British." With Continental opinion always opposed to it, and with Transatlantic support never more than lukewarm, this operation seemed destined to pass out of use altogether save in Great Britain: the revival of symphysiotomy, the perfecting of forceps, the improvement in the technique and results of the Cæsarean section, these all seemed to be driving the induction of labour off the field, and even in this country there were not wanting signs that it was being less employed than formerly. During the past two or three years, however, there have been indications that this despised method was beginning again to attract attention.

It is only fair in judging by results that the operation of *induction of abortion* for medical reasons should be separated from the induction of premature labour: the former has been termed "therapeutic foetocide" (for, of course, it involves the death of the foetus), whereas the latter is performed after the unborn infant is viable, and may save the child as well as the mother. The operations are quite distinct in



their indications, and ought not to be compared in their results. It is doubtful even if it be fair to include the cases in which induction is performed at the end of the sixth or in the seventh month, when the viability of the foetus is hardly established; and certainly the instances in which labour is induced because pregnancy has gone beyond the full term, although their results are often quite satisfactory, cannot be called *premature*, because they are indeed *postmature* labours. If these cases were removed from our lists of operative successes and failures, a much fairer opinion could be formed of the merits of the induction of premature labour.

Among the *objections* which have been made to the performance of artificial interruption of pregnancy, that which has perhaps had most weight has been the high mortality amongst the infants both at birth and within some days or weeks thereafter. In 1902 Ballantyne (*Brit. Med. Journ.*, i. for 1903, p. 1196) insisted that the problem of the premature infant was the root-difficulty standing in the way of a more general acceptance of the operation of induction of premature labour. So long as a third or a half of all infants brought prematurely into the world perished at or soon after birth, so long the operation which brought them there (however well performed and however safe it might be for the mother) would suffer obloquy. Obstetricians had to learn to keep premature infants in life if they were to continue prematurely to bring to a close their intra-uterine existence; the survival of the premature infant was the necessary complement of its early arrival in the world. Ballantyne, therefore, emphasised the value of researches bearing on the anatomy, physiology, and pathology of the premature infant; and he pointed out the self-evident, but little recognised, fact that it was really a foetus placed before its time in an extra-uterine environment which severely tried all its tissues and organs. Camille Hahn's work (*Thèse* (Paris), 1901) on the characters, prognosis, and treatment of premature infants, marked a noteworthy advance in the right direction; and the improvement of the incubator, the scientific study and management of the feeding of such young infants, the aseptic treatment of the umbilical cord, and perhaps the addition of iron to the dietary (as suggested by Ballantyne, *loc. cit.*) may before long so improve the infant's chances of survival as to do away with this, the most serious, objection to the operation of induction of premature labour. At the same time it must not be forgotten that each advance in our successful treatment of the prematurely born infant will tend to push backwards a little the earliest date of viability, and so make possible the performance of induction at an earlier week of pregnancy; in this way there will be a temptation to induce labour earlier in higher degrees of pelvic deformity, and so, for a time, the advances that have been made and the difficulties overcome may be overshadowed by a further advance which brings with it new obstacles. Nevertheless it is in this direction that progress is to be looked for; indeed, it is essential for the very survival of the operation that the peculiarities of the prematurely born infant be studied, and that he be fitted as far as is possible to his environment.

From what has been stated, it will easily be understood that the *indications* for the performance of the operation of induction of premature labour are not, at the present time, well defined. With regard to the commonest indication, the existence of a degree of pelvic contraction which makes it unlikely that a full-time infant can be extracted alive



and uninjured through the canals by forceps, version, or the unaided efforts of Nature, there is a tendency to limit its performance to those cases in which the conjugata vera measures from  $3\frac{1}{4}$  to  $3\frac{1}{2}$  inches (see Munro Kerr's *Operative Midwifery*, pp. 442-444, 1908; and Baisch's *Reformen in der Therapie des engen Beckens* (Leipzig), 1907). But the pelvic measurements are not enough in themselves to decide whether induction should or should not be performed; one must take into account the size and state of ossification of the foetal head, for if these be above the average even a conjugate of  $3\frac{1}{2}$  inches may no longer be large enough to warrant the operation. It is also necessary to remember that the age of the foetus cannot always be ascertained with certainty, and that even when it can be fixed it does not follow that all foetuses of the same age are of the same size. Whilst various plans of antenatal mensuration of the foetus and of its head-diameters have been tried, there seems now to be a consensus of opinion that Müller's method or its modification by Hirst or Munro Kerr (*Journ. Obstet. and Gynaec. Brit. Emp.*, iii. p. 341; iv. p. 293, 1903), by which the foetal head is pressed down into the pelvic brim, and made to act as the pelvimeter, is the most satisfactory (Cooke, *Amer. Journ. Obstet.*, lv. p. 753, 1907). By means of Müller's grasp applied every other day or so the obstetrician will be able to choose the most suitable time for induction, for, of course, so long as the foetal head can be pressed easily through the pelvic brim there is no immediate necessity for the induction of labour. Apart from this, however, it may be stated generally that there is little hope of saving the infant if labour be induced before the thirty-fourth week (*i.e.* six weeks before the full term), and that the most hopeful date is the thirty-sixth week. The obstetrician who is considering induction of premature labour for pelvic contraction is ever on the horns of a dilemma; if he induces it before the thirty-fourth week in order to get a foetus small enough to pass through the maternal canals, the infant will almost always fail to survive its birth, while if he waits till after the thirty-sixth week the child may be too large or have too well ossified a head to pass or be drawn alive through the pelvis. He must also act in accordance with an opinion founded upon three things, none of which can be accurately estimated, *viz.* the age of the pregnancy, the size of the internal pelvic diameters, and the size of the foetal head (Morse, *Amer. Journ. Obstet.*, liv. p. 824, 1906). Yet, with all its difficulties and disadvantages, the induction of labour is a valuable method of dealing with pelvic contractions of moderate amount; it has a very low maternal mortality, it involves no such cutting as pubiotomy and Cæsarean section necessitate, and if a lower foetal and infantile mortality could be achieved it would soon become almost as popular as it is now neglected. Already there are signs of a lessened foetal mortality (Scheffczyk, *Arch. f. Gynaek.*, lxxv. p. 633, 1905), a hopeful indication for the future.

Many other indications for the induction of premature labour are commonly enumerated, such as nephritis, heart disease (valvular), blood diseases, chorea, hyperemesis, and hydramnios; but these stand on quite a different platform from that occupied by pelvic contractions. In most of the conditions named the primary question to be asked is whether the interruption of pregnancy is to be recommended in order to save the mother's life; if this be answered in the affirmative, then the age of the pregnancy will have to be taken into account, for it may be that the foetus is not yet viable, and that consequently an induction of abortion, not of premature labour, will require to be practised. In a word, the life



of the unborn infant is not relatively of such importance in this group of indications; we are operating not so much for the purpose of getting a woman a living child as for that of saving a woman's life without immediate reference to the existence of her foetus. It is quite a different category of cases; and the question to be settled is, whether the disease from which the patient is suffering has so serious a prognosis, and depends to so large an extent upon the pregnancy itself, as to warrant the artificial terminating of the latter. The general trend of obstetric opinion and practice would seem to be greatly to limit the acceptance of these maladies of pregnancy as indications for the termination of gestation, and to encourage the treatment, by medical or surgical means, of the diseases themselves. Of course this conclusion presupposes the putting forth by the profession of a more determined and sustained effort to understand the etiology, pathogenesis, and nature of the maladies which are endangering the mother's life. The study of the pathology of pregnancy must be prosecuted if we are to prevent or cure the diseases peculiar to that state. At the present time, unhappily, the mother is too often allowed to come within sight of death, and then a consultation is asked for to determine whether induction of labour or abortion shall be practised or not; in many cases, especially, perhaps, in those of hyperemesis and chorea gravidarum, it is already too late to discuss the question, and the patient is doomed whether the operation be performed or not. Early recognition of the gravity of such maladies is necessary, and each case must be decided on its own merits. The ideal treatment, of course, will be the cure of the disease with continuance of the pregnancy, and the birth at a later date of a living infant. W. Bokelmann's article (*Samml. zw. Abh. aus d. Gebiet d. Frauenh. u. Geburtsh.*, vii. No. 6, 1907) indicates a strong tendency towards the limitation of the induction of labour or abortion as a means of treating the maladies which may complicate pregnancy; and Williamson (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. p. 252, 1905; ix. p. 184, 1906), who has admirably summarised and digested recent literature, ends his contribution with the warning words that "in many of the conditions discussed it is only under exceptional circumstances that the premature termination of pregnancy is the necessary or proper treatment." It may be added that Schauta (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 318, 1909) regards the artificial induction of labour as an atypical method of treatment (both for contracted pelvis and for medical causes), and puts in its place Cæsarean section, hebosteotomy, or expectant treatment; he would restrict its use to cases "in which the mother is suffering from illness and Cæsarean section or hebosteotomy at the normal term would be too dangerous, or where it is positively known that the children are abnormally large, or the mother absolutely refuses an operation." This may be taken as the extreme German view.

We may now pass to the consideration of the methods of inducing premature labour. It may almost be stated that these resolve themselves into two alternatives—bougie or bag; and it may be added that most obstetricians precede the use of either by preparatory vaginal douching. But whilst this really summarises current opinion and practice fairly accurately, it is necessary to refer, in a few words, to two other plans. When Bossi's metallic dilator of the cervix was introduced into obstetrics, more especially for the rapid emptying of the uterus in eclampsia, it was not long before the suggestion was made that it might be equally well employed for the induction of premature labour in cases



of narrow pelvis. Many obstetricians so employed it, and converted a labour lasting sometimes 3 or 4 days (when a bougie was used) into an operation of a few hours. This can hardly be called induction of labour, it is rather to be described as *accouchement forcé*; and it is generally conceded now that whatever may be the verdict upon the value of Bossi's dilator in other circumstances it is neither a suitable nor a safe means of inducing labour. It is well to bear in mind, as Hannes (*Münch. med. Wochensch.*, liv. p. 1974, 1907) pithily puts it, that while the labour should be artificially induced it ought not to be artificially completed. The other plan for the induction of labour to which reference must be made is tapping the membranes and drawing off the liquor amnii. This is an old method, and it has been carried out in two ways, either by puncturing the membranes with a sound passed through the cervical canal or by perforating them above the os internum with a specially constructed instrument (never an easy procedure); but there was until lately a general consensus of opinion that its disadvantages were much greater than its advantages. The bag of waters, so important as a dilating agent, was lost; the labour was rendered "dry" by the escape of the waters (generally complete by reason of the inability of the presenting part to fit accurately into the brim of the pelvis); and the foetal mortality was higher than with other methods. These disadvantages were held to do more than counter-balance the advantages that were alleged, viz. that the procedure was simple and easy (it was neither when the plan of perforating the membranes high up was tried), that it was certain to be followed by labour pains, that it was painless, and that no anæsthetic was needed. Most obstetricians, therefore, must have read with some surprise that Otto von Herff (*Münch. med. Wochensch.*, lv. p. 2595, 1908) employed rupture of the membranes and thought very highly of it, that Polano (*Münch. med. Wochensch.*, liii. p. 1852, 1906) thought it the most harmless and simplest method, although it might take some time to bring on pains, and that de Reynier (*Beitr. z. Geburtsh. u. Gynaek.*, ix. p. 97, 1904) strongly advocated it. Hannes (*Münch. med. Wochensch.*, liv. p. 1974, 1907), also, although he did not recommend it, did not apparently strongly disapprove of it; he thought it was unnecessary. Munro Kerr (*Operative Midwifery*, p. 446, 1908) took up a more orthodox position in simply ignoring puncture of the membranes; and we shall be surprised if Scheel's method (as it is sometimes called) is restored to favour once more.

In the meantime the method in common use in the maternity hospitals of this country would seem to be the insertion of a bougie between the membranes and the uterine wall. It has been termed Krause's method, but, as Moir (*Trans. Edin. Obstet. Soc.*, xxiii. pp. 15, 153, 1897-8) showed, it was being employed by Professor Hamilton at Edinburgh in the first quarter of the last century. Great care should be taken in sterilising the bougie (usually a large-sized rectal gum elastic one) by soaking it for twenty-four hours in a solution of perchloride of mercury (1 in 1000), and washing off the chemical in lysol solution just before use. Preliminary douching of the vagina should also be carried out for two or three days, and this itself is sometimes sufficient to bring on labour. The bougie is introduced either with or without an anæsthetic: in the former case it can be done with less risk of rupturing the membranes and with more hope of maintaining asepsis, but there is the risk that the sickness which may follow the chloroform will



drive out the bougie or burst the membranes. If hæmorrhage come on during the introduction of the bougie (from separation of the placenta), it must be withdrawn and the cervix and vagina tightly packed with gauze. This accident twice happened to the writer and was rather alarming at the time; but packing stopped it, and in each case the labour followed promptly within twenty-four hours. The bougie, to be effectual, must be pushed well into the interior of the uterus; in fact, the outer end of it should be just within the vulva. It may be left *in situ* for forty-eight hours, and by that time labour pains are often in progress. It is here, however, that the disadvantage of the bougie method is often unhappily evident, for sometimes the uterus retracts very sluggishly to mechanical stimulation, and it becomes risky to leave the rod long inside the organ even when vaginal douches are being regularly given. For this reason, some obstetricians prefer the bag method, at any rate for multiparæ, as it is more certain to excite uterine contractions (*e.g.* Robecchi in Tibone's clinique, *Gior. d. r. Accad. di med. di Torino*, 4 s., ix. p. 806, 1903); but for primiparæ the bougie is still to be preferred. Perhaps the plan pursued by Munro Kerr (*Operative Midwifery*, p. 447, 1908) is the best; the bougie is introduced, and if, at the end of forty-eight hours, labour is not in progress, it is taken out and a dilating bag is put in. Even in a primipara this can usually be done, for the presence of the bougie has made the cervix dilatable.

The other favourite procedure for inducing premature labour is the hydrostatic dilating bag, such as Champetier de Ribes's or Barnes's or Müller's. Pomeroy's bag (*Trans. Amer. Gynec. Soc.*, xxxi. p. 127, 1906) is rather too complicated. The operation is then sometimes known as metreurysis or hystreurysis, the dilator being called a metreurynter. The bag is introduced in a collapsed state into the cervical canal. This may usually be done at once in a multipara; but in the case of a primipara preliminary dilatation is required, and hence many have abandoned the use of the hydrostatic dilator altogether in first labours. Champetier de Ribes's bag is generally allowed to be better than Barnes's, but it requires to be passed in by means of a special pair of forceps. When the bag is well in position in the cervix and lower uterine segment, its action may be assisted by making traction occasionally on it or by attaching to it by means of a string a weight which hangs over the end of the bed (Robecchi, *loc. cit.*). It is well to test beforehand how much fluid is needed to distend the bag, else it may burst *in utero*, always an awkward accident. Labour usually comes on in about fifteen or eighteen hours; and it is good practice to allow the natural efforts to expel the bag, thus thoroughly preparing the canals for the passage of the infant. The greatest inconvenience caused by the bag is its tendency to displace the presenting part. On the whole, it would appear that the hydrostatic bag is more often used by Continental obstetricians (Burger, *Arch. f. Gynaek.*, lxxvii. p. 485, 1905-6; Plauchu, *Lyon méd.*, cviii. p. 144, 1907), and the bougie by British and American authorities (Hirst, *Amer. Med.*, ix. p. 723, 1905). Jardine (*Brit. Med. Journ.*, ii. for 1907, p. 427), however, seems to prefer the bag. Humphrey Davy (*Brit. Med. Journ.*, ii. for 1906, p. 302) would combine the two methods, introducing first the bougie, and, if this be insufficient, inserting some hours later a Barnes bag into the vagina. Some years ago the injection of glycerine into the uterus, or Pelzer's method of inducing labour, was given a somewhat extensive trial, both in this country and abroad; it is now very little heard of, but it is interesting to note that Scheffczyk



(*Arch. f. Gynaek.*, lxxv. p. 633, 1905) uses a sheep's bladder filled with glycerine to set up labour pains, thus combining the oxytocic action of the latter with the mechanical effect of the former. It must, however, be somewhat difficult to be sure that Scheffczyk's "glycerine-bag" is aseptic. At any rate the glycerine method is contra-indicated in cases of nephritis.

Other methods of inducing labour, *e.g.* by plugging the vagina, by tents, by electricity, might be referred to; but they are little used, and an estimate of their value may be found in Williamson's summary (*Journ. Obstet. and Gynec. Brit. Emp.*, viii. pp. 250, 271, 1905). Possibly, in time to come, a chemical excitant of labour, perhaps a placental extract or hormone, which shall be free from the dangerous effects of ergot, may be discovered; theoretically it would seem that uterine action thus set up would be both effective and safe; but no such tocophoric agent is at present known.

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SINCE the beginning of the twentieth century there is hardly a detail in the management of an ordinary labour that has not been criticised, and, in some cases, altered. The midwifery bag, the midwifery bed, the mother's and the infant's binder, the obstetric douche, the cleansing of the obstetrician's hands, the support of the perineum, the vaginal examination, and the technique of the umbilical cord have all been called in question, with the result that, on the whole, labour is now conducted with greater safety because on more nearly aseptic principles than previously. Asepsis is now placed first in the management of a midwifery case, and it is only when, for some reason or other, asepsis is found to be impossible of attainment that the obstetrician falls back upon antisepsis. This means, *inter alia*, that routine vaginal douching with antiseptic lotions in labour and the puerperium has been abandoned, and that reliance is placed upon the thorough cleansing and keeping clean of the vulva and neighbouring parts during the confinement, upon the sterilisation of all instruments which are brought within the genital sphere, and upon the special care of the hands of the obstetrician and midwife (by prolonged scrubbing, washing in antiseptic lotions, wearing of indiarubber gloves, etc.).

With regard, in the first place, to the *obstetrical armamentarium*, various plans were soon suggested for improving the midwifery bag in order to prevent the risk of infection being carried from one case to another in its interstices or on its contents. Its lining was made washable and removable, the bag itself was made large enough to contain a metal steriliser, or a modified bag was constructed consisting in part of a sterilising chamber (see Higgins, *Boston Med. and Surg. Journ.*, cxlii. p. 88, 1900; Lipes, *Ann. Gynec. and Pediat.*, xiv. p. 912, 1900-1901). But none of these plans commended itself very readily to the profession, and it was not till the beginning of the twentieth century that the attempt was made to replace the bag by something that should be a



steriliser first and a bag only in a secondary sense. Edgar, in his *Practice of Obstetrics*, p. 502, 1903, cut the Gordian knot of difficulty by making the obstetric bag consist of two metal trays with a leather cover of a portmanteau shape fitting over them both. The trays were of sheet-iron enamelled in white; one of them was shallower than the other but slightly longer and broader, and in it the deeper but shorter and narrower tray rested when ready for transportation; and while one of them contained the bottles and other glass-ware, the other held the obstetrician's operating-coat, douche, dressings, and instruments. The principle upon which Edgar proceeded was sound: the bag was simple and had no complicated fittings, it was sterilisable by boiling in all its parts (save the cover), it consisted of trays in which the various instruments might be sterilised, and it had a sufficient resemblance outwardly to the ordinary bag so as not to suggest a novelty. J. W. Ballantyne (*Brit. Med. Journ.*, i. for 1904, p. 1303) modified Edgar's bag, making it lighter, smaller, and cheaper, and giving it a washable canvas cover. He proposed further that it should be called an *obstetric satchel*, and that name reserved for any form of metal steriliser contained within a washable or leather cover; the words "midwifery bag" might be given to an ordinary bag of leather closing with a lock or clasp. Ballantyne still further reduced the size of his satchel, and had it made of aluminium for the sake of lightness (*Trans. Edin. Obstet. Soc.*, xxix. p. 194, 1904; xxx. p. 173, 1905). He thought it was to be preferred to the appliances suggested by Veit (*Zentralb. f. Gynäk.*, xvi. p. 440, 1892), by von Herff (*ibid.*, xix. p. 1033, 1895), by Fehling (*ibid.*, xix. p. 1062, 1895), by Albers-Schönberg (*ibid.*, xix. p. 1361, 1895), and by de Seigneux (*ibid.*, xxvii. p. 1240, 1903). Certainly there seems to be a growing practice in the profession of sterilising instruments and the like before attending upon a confinement case, of taking the armamentarium wrapped up in clean towels to the patient's house in a steriliser of some sort, and of re-sterilising at the case such implements (*e.g.* forceps) as may be required. It is more than likely that modifications in the construction and mode of preparation ("guarding") of the *labour bed* in private as well as in hospital practice will be introduced. In the maternity hospital the labour bed is now practically an operating-table in the later stages of the confinement; but in ordinary practice the obstetrician delivers his patient on her own bed prepared in various ways (with mackintosh sheeting, wood-wool pads, draw sheet, etc.) for the event. The labour-bed (Gebärbett), which has been introduced by Miklaschewsky (*Zentralb. f. Gynäk.*, xxxi. p. 504, 1907), can, it is true, be easily converted into an operating-table; it makes the thorough cleansing and irrigation of the genital organs much easier; it allows the patient to be quickly put into Walcher's position or into Trendelenburg's; and it lessens the number of assistants necessary in complicated and instrumental cases. Nevertheless, labour-beds of this type can hardly be looked for in private practice, and the general practitioner will have to content himself with the ordinary bed, protected as far as possible by means of waterproof sheeting and kept clean with antiseptic pads and sterilised towels. Wooden blocks, with small depressions in their upper surfaces, may be used for raising the lower or upper end of the bed as circumstances may demand.

Another question in connection with the management of labour which has arisen during the past few years is the protection of the hands of the obstetrician with *rubber gloves* and of his face with a *mask*.



Many articles dealing with this matter have appeared, among which may be named Schumacher's paper (*Arch. f. Gynaek.*, lxxviii. p. 399, 1903) and Maguire's (*Detroit Med. Journ.*, iv. p. 198, 1904-5), as well as numerous short references in the *Zentralblatt für Gynäkologie* (e.g. xxxi. pp. 12, 251, 757, 872, 885, 1302, etc.). It may at once be stated that the *face mask* is not in use for ordinary confinements, and is not likely to be employed save for Cæsarean sections and the like. With regard to *rubber gloves*, there is a considerable difference of opinion, and, of course, circumstances alter cases. Certainly, if a medical practitioner be called to a midwifery case after dealing with any septic wound or any condition suspected to be septic, he will be well advised to wear rubber gloves which have been freshly sterilised; if, in addition, he find it necessary to pass a hand into the cavity of the uterus during the confinement, the putting on of the gloves will be clearly indicated (Wormser, *Deutsche med. Wochens.*, xxx. p. 1645, 1904). At the same time, he will not be released from the necessity of cleansing his hands as thoroughly as he would have done if he had not been about to employ gloves. It must ever be borne in mind that rubber gloves do not replace handwashing and disinfection; they are an additional safeguard, not an alternative measure of precaution. It will probably be found from experience that if a medical man is careful to put on gloves in dealing with doubtful cases in his general practice, he may with safety use his bare hands in his midwifery work; he will find it easier to proceed in this way rather than attempt to work in gloves in all his confinement cases, many of them extending in time over some hours and necessitating frequent sterilising of the gloves. But, if he have on occasion to remove the placenta manually or to make any such intra-uterine manipulation, he may for additional security put on the rubber glove. There is one disadvantage in so doing, the difficulty which exists in grasping the leg of the child in version, and in removing pieces of retained or adherent membrane, and Munro Kerr (*Operative Midwifery*, p. 310, 1908) has had under such circumstances to remove the gloves before he could accomplish his purpose. There is, however, another standpoint from which this question may be looked at: if the medical man know or suspect that his parturient patient is suffering from sepsis, gonorrhœa, or syphilis, he will find it necessary to protect himself and his other patients by covering his hands during any manipulations which may become necessary. To sum up: the medical man ought to carry a pair of rubber gloves in his obstetric satchel for use in exceptional cases and under special circumstances.

The question of prophylactic *vaginal douching* in ordinary midwifery practice remains very much where it was when the sixth volume of the *Encyclopædia Medica* was published (see VI. p. 185). *Routine douching* before, during, or after labour is probably not practised anywhere now; but vaginal douching with lysol or with one of the mercuric salts, when there are indications that the mucous membrane of the canal is in an unhealthy state (free purulent discharge), when an operation of greater magnitude than forceps application at the outlet is to be employed, or has been employed, and when the placenta or membranes have had to be removed with the hand thrust deeply into the utero-vaginal canal, is regarded by many obstetricians as not only permissible but desirable. The abolition of routine preliminary douching is largely due to the result of such carefully conducted comparative methods of investigation as were instituted by K. Baisch (*Arch. f. Gynaek.*, lxxix. p. 325, 1906);



from these observations it emerged that rises of temperature were more common in douched than in undouched patients, even when rubber gloves had been employed in giving the douches, and even after careful vulvar cleansing had been carried out. One is led to the conclusion that prophylactic douching in normal cases is harmful even when gloves are worn and the vulvar toilette is not omitted, and that, therefore, it is still more dangerous when these precautions are not taken. In the exceptional circumstances, above referred to, the douche, however, may, in the opinion of many, be wisely employed, not, of course, without the other precautions (careful handwashing and vulvar cleansing). The vaginal and intra-uterine hot douche (temperature 118° F.) is also of considerable value in the checking of post-partum hæmorrhage. Vulvar cleansing is now regarded as the important thing; but it is unnecessary to shave the hair, although it may be well to clip it short if it be very long (Herman, *Brit. Med. Journ.*, i. for 1906, p. 1516). The *cleansing of the obstetrician's hands*, all are agreed, must be carefully and repeatedly carried out during the progress of a confinement case. It is now admitted that it is impossible to *sterilise* the hands, but thorough cleansing of them gives a degree of security which is very nearly complete, and it is matter for congratulation that this thorough cleansing can be carried out without elaborate apparatus. With hot water, soap, and a clean nail-brush much can be accomplished, if the obstetrician will only give time enough to the scrubbing of the hands and nails, if he will rinse frequently and use running water, and if he will repeat these cleansing operations each time that he examines his patient. A midwifery case differs from even a prolonged surgical operation in the fact that there are times during its progress when, of necessity, the hands of the obstetrician must, by touching unsterilised things, become technically unclean again. It is also to be borne in mind that, as the labour lengthens, and as the amount of interference required increases, the attendant ought to increase the care he bestows on the disinfection of his hands; too often, unfortunately, the very opposite plan is pursued, and with continued delay, and more particularly with rapidly arising danger, precautionary cleansing is apt to be perfunctorily performed, or omitted altogether. Perhaps the most important modification in the actual technique of handwashing which has been introduced of recent years, is the employment of alcohol for the removal of fatty matter as well as for its antiseptic and skin-hardening action (Tjaden, *Zeitsch. f. Geburtsh. u. Gynäk.*, xxxviii. p. 351, 1898; von Herff, *Münch. med. Wochensch.*, lii. pp. 1132, 1203, 1905; etc.). Many now cleanse the hands by first washing thoroughly with hot water and soap, using the nail-brush persistently, and changing the water frequently; the hands are then rubbed with turpentine and washed in methylated spirit; finally they are soaked in, and washed with, a solution of perchloride of or biniodide of mercury. It is useful to dip the hands in a solution of lysol just before they are introduced into the patient's vagina, for the lysol, by its oily character, aids their passage and does away with the necessity for the use of such unguents as vaseline (which, in the past, were often a source of danger rather than a means of security).

Since (in 1847) Sir James Young Simpson introduced *anæsthesia* into the management of labour, normal and abnormal, using, first, ether, and, later, chloroform, more than sixty-two years have passed away. After the first prolonged and stormy opposition to the use of anæsthetics in



labour had been met, there followed a period of calm acquiescence in the practice on the part of the profession, and it is only within the past few years that the routine employment of chloroform has been challenged anew. A good deal of what has been written regarding the danger of this anæsthetic in midwifery practice has been founded on experience gained in surgical practice, but, as has been pointed out many times, surgical and obstetrical anæsthesia can hardly be fairly compared. Careful scrutiny of statistics and of the views of obstetricians shows that chloroform in midwifery practice is singularly free from risks, and while this immunity from danger has been variously explained as due to the elimination of emotion, the absence of the fear of operative consequences, the presence of acute pain, etc., the true explanation would seem to be the threefold one given by Alex. Ballantyne (*Trans. Edin. Obstet. Soc.*, xxii. p. 13, 1896-7). According to this obstetrician the increase of vascular tension in pregnancy, the increase in the total mass of blood in the system, and the eccentric hypertrophy of the heart, all tend to meet and overcome the dangers of chloroform anæsthesia, these dangers being chiefly paralysis of the vasomotor and respiratory centres and of the cardiac ganglia. Chloroform, in pregnancy, is acting upon a system specially prepared to resist its dangerous effects and to utilise its pain-assuaging ones to the full. "During a pain the rapid action of chloroform is quickly recovered from by the forced expiration, and the nerve-centres, temporarily stimulated by the increased respiration, resist the effect of the depressing agent, while the general high blood-pressure furnishes a reserve power of resistance against any untoward effect or excessive amount of the anæsthetic." Perhaps, also, the dilatation of the vagina and external parts in labour acts as a constantly recurring stimulus to the respiratory centre. Chloroform, then, is remarkably suited to produce either the incomplete anæsthesia called for in natural labours to relieve the patient's sufferings, or the more complete anæsthesia required for the performance of such obstetric operations as version or symphysiotomy. For the first object it is given towards the close of the second stage and intermittently; the towel or mask is brought near to the face with the advent of each pain, and removed in the interval; but when the infant's head is actually distending the perineum and passing over it, the administration of the anæsthetic may be more nearly continuous. When it is given for the second purpose—the induction of full anæsthesia—the same precautions should be taken, and the same plans followed as in surgery, although even here the "obstetrical immunity" to danger can be observed. The good effects of chloroform in obstetric cases complicated by heart disease have been noted by many observers; but it ought to be remembered that the third stage of labour does not continue to enjoy the immunity from danger which is present in the first and second stages, and this remark applies not only to labours complicated with heart disease, but also to those which are natural. The chloroform towel or mask should be removed from the patient's face, and, indeed, from her vicinity altogether, after the birth of the child's head.

Whilst the foregoing are the views which are generally held regarding the use of chloroform in midwifery practice, no review of recent literature would be complete without a reference to the statements which have been made regarding the necessity for anæsthesia in labour. J. Veit (*Therap. Monatsh.*, xxii. p. 609, 1908) goes back to the arguments and standpoint of sixty years ago, and maintains that labour is a



normal function and should be conducted without recourse to an anæsthetic, save in the case of neurasthenic women attended by a neurasthenic physician. This is obviously an extreme view, and it is one which Veit's fellow-countrymen apparently do not share in; Prof. von Krönig, for instance (*Brit. Med. Journ.*, ii. for 1908, p. 805), recognises the necessity of diminishing labour pains, especially in the case of sensitive and nervously-disposed women, and points out that, besides conferring a benefit upon the women in so doing, we remove factors which might have an injurious effect. Newell (*Surg., Gynec., and Obstet.*, iii. p. 126, 1906) goes further, and would allow the patient an anæsthetic even in the first stage of labour, believing that the sufferings of the lying-in woman deserve relief even before the cervix is fully dilated. It may, at any rate, be regarded as generally admitted that the pains even of a natural labour are so severe as to call for some assuagement.

But all obstetricians are not agreed that this alleviation of pain can be best or most safely obtained by the inhalation of chloroform. For a time it seemed as if *spinal anæsthesia* might succeed in establishing itself as a means of abrogating suffering in confinement cases. At first a sterilised 2 per cent. solution of cocaine was used, and from 1 to 2 grammes were injected into the spinal cavity by means of a needle introduced between the third and fourth lumbar vertebræ, about half an inch to one side of the middle line; then other drugs began to be employed, such as eucaine, novocaine, and stovaine; but the method, whatever agent be used, has its inconveniences (such as the throwing out of action of the secondary powers of labour), and its employment has been accompanied by dangerous and even by fatal results. (See Lea's review of the subject in the *Journ. Obstet. and Gynec. Brit. Emp.*, i. p. 83, 1902; Martin's views are given in the *Münch. med. Wochensch.*, li. p. 1817, 1904; A. Falkner, in the *Zentralb. f. Gynäk.*, xxxi. p. 65, 1907, gives an account of evil after-effects; see also Krönig and Gauss in the *Münch. med. Wochensch.*, liv. pp. 1969, 2040, 1907.)

*Ether* continues to be used in midwifery practice in several parts of the world, notably in the United States of America. It was the agent which Sir James Simpson employed when, in January 1847, he introduced anæsthesia into obstetric practice; but later in the same year he abandoned ether for chloroform, finding that the latter was more portable, potent, and pleasant, and less irritating to the air-passages. On the other hand, chloroform is more dangerous than ether in *surgical* practice, and it has been argued that it will necessarily be so in midwifery likewise; and this consideration has, no doubt, influenced obstetric practice in the United States, in Ireland, and in England. Jewett (in Norris and Dickinson's *Obstetrics*, i. p. 413, 1902) thinks that the use of ether for partial anæsthesia is growing in America, and advises that it be always employed for complete anæsthesia. On the other hand, the writer of an editorial in *American Medicine* (June 1903) states that the safety of chloroform in midwifery is now conceded, and that most obstetricians prefer chloroform in obstetric operations. Whitridge Williams (*Obstetrics*, p. 321, 1908), also, favours chloroform as compared with ether, and regards "religious objections" on the part of the patient as almost its only contra-indication. It may be said, in passing, that Baldy (*Trans. Amer. Gynec. Soc.*, xxxiii. p. 6, 1908) paints rather a gloomy picture of the giving of anæsthetics in America (apparently referring to ether), and suggests that, in order to get over



the difficulty of attracting skilled anæsthetists, women should be employed at smaller salaries. *Ethyl chloride* has been used as an anæsthetic during labour when deep anæsthesia by ether or chloroform was not called for. Lepage and Le Lorier (*Ann. de la Polyclin. de Paris*, xiii. p. 160, 1903) have recommended it on account of the ease of administration, the rapidity with which anæsthesia is produced, the rapid recovery, and the freedom from unpleasant after-effects; it is said to be specially useful for short manipulations, such as forceps, internal version, removal of placenta or membranes, and suturing the perineum. Anæsthesia may be begun with ethyl chloride and continued with chloroform, if necessary (Müller, *Deutsche med. Presse*, ix. p. 76, etc., 1905). But, again, ethyl chloride is not without inconveniences and dangers (*e.g.* spasm of the masseter muscles), and its administration has been the cause of death (*vide* Luke's article, *Internat. Clinics*, S. 15, vol. iii. p. 214, 1905).

Within the past few years, however, a still more formidable competitor has sprung up among the anæsthetics which may be used in midwifery practice. This is scopolamine (or hyoscine) given hypodermically in combination with morphine in order to produce semi-narcosis or drowsiness (*Dämmerschlaf* of the Germans) during labour. It was introduced by Steinbüchel into obstetrics. As practised by Gauss (*Arch. f. Gynaek.*, lxxviii. p. 579, 1906; *Münch. med. Wochensch.*, liv. p. 157, 1907; *Zentralb. f. Gynäk.*, xxxi. p. 33, 1907) the method consists in the injection of about  $\frac{1}{130}$  gr. of hyoscine hydrobromate and  $\frac{1}{8}$  gr. of muriate of morphine; the anæsthetic effect is fully evident in an hour, or in three hours at the latest; thereafter a second injection (with a smaller dose of morphine) may be given, and, if the labour be prolonged, still more medication with half doses may (according to Gauss) be carried out. The first dose is given when the pains begin to be distressing, and it is claimed that the method is safe for mother and foetus, that it does not affect the strength of the uterine contractions, and that it sufficiently relieves the pain of labour and prevents unpleasant memories of suffering. These are the opinions, founded upon 1000 cases, advanced by Gauss, and they are supported by Preller from a smaller experience (*Münch. med. Wochensch.*, liv. p. 161, 1907), by Newell (*Surg., Gynec., and Obstet.*, v. p. 153, 1907), and by Lehmann (*Zeitsch. f. Geburtsh. u. Gynäk.*, lviii. p. 297, 1906), although the last-named author mentions the deleterious effect of the drug upon the foetus. On the other hand, there is evidence that the scopolamine-morphine method is not without its disadvantages and risks. Steffen (*Arch. f. Gynaek.*, lxxxi. p. 451, 1907), Hocheisen (*Zeitsch. f. Geburtsh. u. Gynäk.*, lix. p. 131, 1907; *Münch. med. Wochensch.*, liv. p. 529, 1907), and Bertino (*Ginecologia*, 31st Oct. 1907) have all written strongly on this aspect of the subject. Steffen, for instance, found that the uterine contractions were weaker in 38·3 per cent. and stopped altogether in 5 per cent.; Hocheisen noted weakening in 33 per cent. and arrest in 3 per cent.; the former observer stated further that the pain accompanying the contraction was unchanged in 18·6 per cent., and both he and Hocheisen found some inconvenience from the fact that the patients were unable voluntarily to control the contraction of the abdominal muscles at critical periods (*e.g.* when the head was crossing the perineum). Bertino, as well as Steffen and Hocheisen, noted that several of the infants at birth showed symptoms due to the hyoscine and morphine; Bass, also, reported unfavourably in respect to the state



of the foetus (*Münch. med. Wochensch.*, liv. p. 519, 1907). Gauss himself allowed that 18·1 per cent. of the children were affected with what he termed oligopnoea, and Holzback (*Münch. med. Wochensch.*, liv. p. 1228, 1907) has proved that this condition, when it persisted after birth, might in part be due to hyoscine passing from the mother's system by the milk to the child. Then, again, it has been stated that the hyoscine causes excitement and even delirium, that atonic uterine hæmorrhage may follow, and that the circulation may be dangerously affected, although it must be added, in respect to the last-named inconvenience, that Gauss used the method with good results in twenty-three cases with marked heart disease. It may be stated here that the drugs require to be pure and invariable, that the solutions must be made with distilled water and sterilised, and that they should be kept in the dark. That the scopolamine-morphine method has not completely answered expectations is shown by the fact that Professor Krönig (whose assistant is Dr. Gauss) recommends the inhalation of ethyl chloride as the child's head is passing over the perineum, and the administration of a small dose of veronal to quiet the nervous system at the opening stage of labour (*Brit. Med. Journ.*, ii. for 1908, p. 807). Some of those who have used the scopolamine-morphine method emphasise the need for close watching of the patient while she is under the influence of the drugs, and would therefore restrict its use to hospitals; others, such as R. C. Buist (*Brit. Med. Journ.*, ii. for 1908, pp. 809, 1044), find attractions, for private practice, "in a method which relieves the patient's sufferings while it allows labour to progress regularly, and which does not require the constant personal presence of the medical practitioner as the obstetric anæsthesia with chloroform does." Whilst it cannot be said that the scopolamine-morphine method has established itself with any degree of security in obstetric practice either in Germany, America, or in this country, neither has it, as yet, been shown to be so unsuitable or so dangerous for mother or foetus as to forbid further experiment being made with it, both in hospital or private practice. One has a feeling that it will probably give way, as so many other new plans have done, to chloroform inhalation; but it is only fair that it should have a prolonged trial. It may be true that chloroform inhalation weakens the pains of labour and lengthens the intervals, although there is evidence against as well as for this statement (*vide* M'Kerron's summary in the *Edin. Med. Journ.*, N. S. ii. p. 581, 1909), and so delays the birth of the child; it may be, also, that there is an increased tendency to third-stage bleeding and post-partum hæmorrhage when chloroform has been employed (more especially if complete anæsthesia has been required); but these inconveniences can all be minimised by giving the chloroform with care and in accordance with the rules for obstetric anæsthesia, and the general practitioner will doubtless continue so to use it until some other drug or some other method has established a much stronger claim upon him than either spinal anæsthesia or the scopolamine-morphine plan has yet done.

When so many long-established methods of managing confinement cases are being attacked, it is little wonder that the *obstetric binder* (maternal and infantile) has come under censure. Of course, the wearing of a binder after labour is a national rather than a universal custom, being, for instance, common in Great Britain and America, and uncommon in Germany; but within the past few years it has been much discussed, even in the last-named country, and Bröse (*Berl. klin.*



*Wochensh.*, xliii. p. 1339, 1906) now argues for its general adoption there, and Semmelink (*Zentralb. f. Gynäk.*, xxix. p. 1595, 1905) describes a new model. On the other hand, it has been criticised in America, and Whitridge Williams (*Obstetrics*, p. 341, 1908) has probably voiced the extreme view when he writes: "I am not in favour of its employment, and do not believe that it serves any of the purposes for which it is recommended. On the other hand, I am of the opinion that it occasionally gives rise to retroversion or retroflexion of the enlarged and soft uterus, especially if it be applied sufficiently snugly to exert compression. . . . Nor can I find any evidence of its value in restoring the figure, which will gradually return without its use, provided the tonicity of the abdominal muscles be retained." In conclusion, Williams thinks it can do no harm after the tenth day, and that "it is perhaps as well to permit its use by those patients who feel strongly that it will aid in restoring the figure, for if it be forbidden the physician will probably be blamed in case a shapeless figure follows." Edgar (*Obstetrics*, p. 730, 1903), however, names its advantages and urges its employment: "It tends to prevent atony and lack of contraction in the uterus, splachnoptosis of the abdominal viscera, and obviates the danger of sudden filling of the abdominal veins due to the greatly lessened abdominal pressure after confinement; the binder, when properly applied, conduces to the patient's comfort, especially by permitting her to assume the lateral position." With regard to the material of which the binder is made, unbleached muslin is preferred by Edgar, and a sort of crape, very elastic, porous, and airy, by Bröse (*loc. cit.*). It cannot be admitted that a convincing case has been made out against the routine use of the binder, although, perhaps, the patient and nurse may expect too much benefit to accrue from its employment; there can be little doubt that it adds to the comfort of the lying-in woman, and, for this cause alone, it may well be continued, unless it can be definitely proven to do harm. In addition to its routine use immediately after labour and in the puerperium the obstetric binder may occasionally be employed during the course of labour; it has been found to be valuable in maintaining the foetus in its corrected presentation and position after version has been performed, and in some cases of accidental hæmorrhage with or without vaginal plugging. The *infant's binder* has also been objected to as unnecessary, or dangerous, or both. Waring (*Brit. Med. Journ.*, i. for 1908, p. 1410), for instance, states that the only possible justification for its use is its protection of the ligatured cord, and he names the following evils which he thinks may be ascribed to its employment, viz. discomfort, vomiting, inguinal and umbilical hernia, prolapsus ani, thoracic deformities, and overlaying. It is possible, indeed probable, that when the infant's binder is tightly applied, some of these evil results may follow; but there seems to be a general consensus of opinion that, if properly applied and fixed by means of a few stitches down the back, it keeps the cord in position and free from injury, and so serves a useful purpose.

The ordinary *treatment of the umbilical cord* of the infant is another detail in the management of labour which has passed under criticism during the past few years. As long ago as 1899 Dickinson (*Trans. Amer. Gynec. Soc.* for 1899) asked the question, "Is the sloughing process at the child's navel consistent with asepsis in child-bed?" and of course there could be no possible answer save one in the negative. The question had only to be formulated in order to be answered. The



ordinary method of treating the cord by tying it at two places and dividing it, and then allowing the stump of it which was left attached to the infant's umbilicus to slough off in five or six days, cannot be called a germ-free plan, even if antiseptic lotions and dressings be carefully employed as well. With such a mode of management there is the risk, when the cord-stump separates (or sooner), of microbic infection invading the child's body by the way of the umbilical vessels, more especially if these vessels are long in closing, as there is reason to believe is the case in premature infants (Audion, *Bull. et mém. Soc. anat. de Paris*, S. 6, ii. pp. 241, 291, 1900; J. W. Ballantyne, *Physician and Surgeon*, i. p. 988, 1900; Keller, *Zeitsch. f. Geburtsh. u. Gynäk.*, lviii. p. 454, 1906). Various plans have consequently been suggested in order to obviate the risks attendant upon funic separation by sloughing. Ligation of the cord closer to the abdomen than the point usually selected has been tried (Martin) with red-hot scissors as the cutting agent; Duke (*Brit. Med. Journ.*, i. for 1903, p. 615) clamped the stump and so reduced the portion of dead funic tissue adhering to the abdominal wall to a minimum; Gelli (*Boll. d. Soc. Toscana di ostet. e ginec.*, i. p. 13, 1902) used a simple clamp, shaped something like a safety-pin; Bacon (*Journ. Amer. Med. Assoc.*, xxxviii. p. 1071, 1902) cut the Whartonian jelly at the base of the cord and tied the vessels with fine silk or catgut; and even angiotripsy has been recommended. J. W. Ballantyne (*Brit. Med. Journ.*, i. for 1909, p. 944) tested six different methods in his hospital practice, *e.g.* tying the vessels separately, stripping back the sheath of the cord and ligaturing the rest of the cord *en masse* or the vessels in detail, stripping off the sheath and transfixing the contents and ligaturing them in two portions, etc.; but in the end he was led to prefer cutting off the cord flush with the skin of the umbilicus, tying the vessels individually, rawing the skin margins, and bringing them together. By the method last named he was able to get healed stumps with some signs of retraction at the fourth day. A somewhat similar procedure was found by Dickinson (*loc. cit.*) to give the best results also. No doubt the ideal plan is the complete removal at once of any funic tissue which is destined to die, and the closure of the wound by surgical methods; but, while such a plan may be carried out with advantage in Maternity Hospitals, it would be difficult to apply it in private practice. Under the latter circumstances the method of ligation with the subsequent application of moist or dry antiseptic dressings to the stump will still maintain its place; but it may be found to be good practice to compress the stump before tying it, so as to squeeze out as much of the Whartonian jelly as possible. It may be added that Ahlfeld (*Deutsche klin. Wochensch.*, xxxiv. p. 225, 1908) advises tying the cord for the first time about four inches from the umbilical ring, and then in about an hour and a half religaturing it as close as possible to the body of the child; the infant gets his bath between the two tyings.

It is not clear that any great change has been made during the past quinquennial period in the method of "*supporting*" or "*protecting*" the *perineum* during the passage of the child's head. It is now generally recognised, on the one hand, that meddlesome interference is not always the cause of perineal laceration; and, on the other hand, it is conceded that the most perfect method of support or protection will sometimes fail to preserve the structural integrity of the part. It would seem to be most desirable that the occipital end of the head as far as the nape of the neck should be born under the pubic arch before extension of the



head be allowed to take place, for in this way the small sub-occipito-bregmatic diameter passes through the vulvar ring; it is also advisable that time be allowed (while the head "swings") for the dilatation of the perineum. The passage of the head over the perineum, like the third stage of labour, is a process rather than an act, and requires time for its due performance. Various plans may be adopted in order to prevent the premature undoing of flexion and to bring about the birth of the occiput before the forehead is allowed to swing over the perineum (see Apfelstedt, *Berl. klin. Wochensch.*, xliii. p. 1536, 1906; Toff, *Münch. med. Wochensch.*, liv. p. 525, 1907; Ahlfeld, *Deutsche med. Wochensch.*, xxxiii. p. 2121, 1907); but the principle is the same, and the method which involves as little handling of the parts as possible is no doubt the safest if not actually the best. Both the left lateral and the dorsal position of the patient have their advocates; there is a difference of opinion also as to the usefulness of an anæsthetic at this stage, and there are many ways in which manual or digital pressure is recommended to be applied to the advancing forehead; but perhaps Toff's method (*loc. cit.*) is as satisfactory as any. The patient lies on her left side; the obstetrician stands at the right side of the bed facing her; when the head appears at the vulva he lays his hand thereon, with the fingers directed towards the symphysis pubis; at each pain he tries to bring down more of the occiput, increasing the flexion; when the occiput has passed under the symphysis and the nape of the neck can be felt under the bone, then, and not till then, does he relax his pressure and allow extension to take place.

The controversy of ten or fifteen years ago regarding the *management of the third stage* of labour has now been almost forgotten, and a safe *via media* has been found between the method of rapid expulsion of the placenta which was fostered by the use of the Credé grasp and the plan of leaving the after-birth for hours in the hope of getting spontaneous expulsion (expectant method). Whether the placenta is separated from the uterine wall mainly during a pain or chiefly during the intervals of relaxation may be left uncertain; but the plan of treatment usually followed is to keep the hand on the fundus during the third stage, to gently knead the uterus if it become very soft and lose its rounded shape between the contractions, to wait until the organ becomes markedly smaller and harder (usually after five or six alternate hardenings and relaxations), and then to aid expulsion by compression, or if it do not undergo these changes in three-quarters of an hour or an hour, or if hæmorrhage occur, to expel it by grasping and squeezing the uterus. Berry Hart (*Edin. Med. Journ.*, N. S. ii. p. 532, 1909) is still of opinion that the placenta separates *after* the pain, and that the safe time to use hand-grasping of the uterus is after the placenta has separated. British obstetricians, who have widely accepted Matthew Duncan's view that the edge of the placenta is the first part to emerge from the cervical canal, will be surprised to learn from Von Winckel (*Deutsche med. Wochensch.*, xxxiv. p. 49, 1908) that in 76 per cent. of all cases the after-birth is expelled in inverted fashion by a more or less extensive hæmatoma situated retroplacentally, as was described by Schultze.

Whilst there has been (as we have seen) much discussion lately regarding the details of the management of an obstetric case, it remains to be added that the whole question of interference *versus* non-interference in natural confinements has been the subject of a prolonged and



somewhat angry controversy in British medical literature during the past three or four years. In March 1906 the late Dr. Horrocks's address on "The Midwifery of the Present Day" was published (*Brit. Med. Journ.*, i. for 1906, p. 541). In this paper and in the letters and articles which followed it (vide *Brit. Med. Journ.*, i. for 1906, pp. 712, 713, 737, 773, 831, 949, 1012, 1073, 1132, 1199, 1259, 1383, 1448, 1509, 1572; ii. for 1906, pp. 114, 225, 330, 399, 452, 600, etc.) we find marshalled once more in order the arguments for and against interference in labour: on the one side it is stated that 90 or more, probably 95, per cent. of all labours are normal, that "a woman can in most cases deliver herself successfully, without help, without instruction, and without knowledge beyond her own instincts," that parturition is a well-nigh perfect physiological act, that what is needed in its management is patience and ever more patience to give Nature time to act, and the banner which flies over this army of opinion is "meddlesome midwifery is bad"; on the other side, are the reasons for expediting labour, the pain suffered by the parturient woman (severe even in the most normal of confinements), the enervating and debilitating effects of modern conditions of life, the effects of civilisation in increasing the difficulty and consequent delay met with in labour, the frequency of minor troubles following prolonged parturition, and the ease and safety with which manual and instrumental means may be employed, and the watchword of this body of opinion is that "delays are dangerous." It is simply the renewal of the old controversy of sixty or seventy years ago under modern conditions. With anæsthesia we can lessen or remove the pains of childbirth, and with aseptic and antiseptic methods and the use of well-contrived instruments we can expedite labour with almost complete safety to mother and child; it is little matter for wonder that busy general practitioners apply forceps more often than of old, and believe that by so doing they are conferring a benefit upon suffering women. Against them who act thus Dr. Horrocks spoke strongly, saying "that in these days it is little short of criminal to terminate normal labours as quickly as possible by the use of forceps or manual interference." In the fact that such interference could be rendered safe by modern asepsis Horrocks saw no reason for departing from his strongly expressed opinion; but it is quite evident that this circumstance has an important bearing upon the question, and does go far to justify more frequent resort being made to instrumental aid. It is easy to see also that the very ease and safety with which interference can be carried through is a temptation to treat every case (not actually precipitate) as one requiring artificial assistance. Perhaps the safe modern position in midwifery practice may be said to be founded on the following general principles: (a) to adopt the policy of watchful, alert waiting, not interfering so long as the natural forces are acting naturally, but doing so immediately when Nature's forces are inefficient or wrongly directed; (b) to strive after cleanliness, surgical cleanliness, in patient, in doctor, and in nurse, making asepsis the first line of defence and antisepsis the second, touching the patient's genital organs only with clean hands or boiled implements, and not allowing her natural defences (germicide vaginal mucus, etc.) to be removed or her strength to be depreciated; and (c) to repair at once all injuries, such as perineal, vulvar, vaginal, and cervical lacerations (Ballantyne, *Essentials of Obstetrics*, p. 58, 1904).



**Labour : Post-partum Hæmorrhage.**

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REFERENCE has already been made to recent advances in the treatment of placenta prævia and accidental hæmorrhage (see ACCOUCHEMENT FORCE and CÆSAREAN SECTION); but there is another condition associated with labour in which bleeding is the prominent symptom, viz. post-partum hæmorrhage, and to that dangerous complication of childbirth it is necessary to direct attention.

CAUSATION.—It is generally admitted that the commonest cause of post-partum hæmorrhage (including under that term not only the bleeding which occurs after the completion of the parturient process (true post-partum hæmorrhage), but also that which takes place before the expulsion or removal of the placenta (third-stage hæmorrhage)), is a relaxed condition of the uterus. At the same time it is necessary to remember that other causes may be at work. The bleeding, for instance, may be due to lacerations or tears of various structures in the genital tract from the cervix to the vulva. In such a case the bleeding begins soon after the birth of the child and continues, unaffected by the state of contraction, retraction, or relaxation of the uterus; indeed, one should always look for a laceration when there is post-partum bleeding with a firmly contracted uterus. Cervical and perineal tears are common causes, and the former may be associated with considerable danger if they extend into the vaginal roof; but there are also the less frequent vaginal and vulvar lacerations to be taken into account. Vaginal tears of considerable gravity may be met with in labours following upon such operations as colporrhaphy (anterior and posterior) and colpo-perineorrhaphy; for gynecologists are prone to constrict the vaginal canal to a high degree in order thoroughly to prevent the descent or backward displacement of the uterus, forgetting in their zeal to obtain a good gynecological result that a subsequent pregnancy and labour may take place, and that an infant with head diameters of four inches or thereby may have to pass through the constricted canal. Vulvar lacerations also may be the cause of considerable bleeding, those in the neighbourhood of the clitoris being specially troublesome; occasionally such cases have had a fatal ending, as in that reported by Kossov-Gerronay (*Wien. klin. Wochensch.*, xviii. p. 1334, 1905).

TREATMENT.—The treatment of post-partum hæmorrhage due to lacerations at any level in the cervico-vulvar tract should be immediate repair of the tear. In slight cases hot vaginal douches or the temporary application of pressure-forceps or of plugs may suffice, but immediate suturing gives the best results, preventing, as it generally does, both sepsis and subsequent cicatrization. Difficulty, however, may arise in connection with cervical lacerations which invade the vaginal roof and open into the parametrium, producing a deep cavity; under these circumstances the pulling down of the cervix and the closure of the cervico-vaginal wound may leave the bleeding in the parametrium unchecked, and even plugging of the large parametric cavity may be insufficient. In such an emergency Fritsch (*Deutsche med. Wochensch.*, xxx. p. 19, 1904) recommends the application of double pressure: he first expresses the placenta; then, with the right hand, he presses the anteflexed uterus deeply down into the pelvis; at



the same time, with his left hand, he pushes the labia majora upwards towards the sacral promontory; in this way pressure is applied on both aspects of the pelvic floor, and the bleeding in the parametrium is checked. The pressure may have to be kept up for half an hour or longer.

The proper treatment of the common form of post-partum hæmorrhage, that due to relaxation of the uterus, has generally been regarded as fairly well established and fixed. Teachers and practitioners of obstetrics, as well as most text-books of midwifery, have emphasised the importance of applying pressure to the uterus by the hands, and of thus checking bleeding by causing uterine contraction, and by favouring the supervention of uterine retraction. It is true that some writers of text-books, in their desire to name all the means of treatment which may prove beneficial in the various degrees and varieties of post-partum bleeding, have enumerated so many plans of procedure (hot douches, hypodermic injections of ergotin, bandaging the limbs, injection of saline *per rectum* or under the breasts, plugging the uterus, administration of stimulants, etc., etc.) that no single doctor, even when aided by a reliable nurse, could possibly hope to put them all into operation and continue to grasp the uterus with both hands; but it is doubtful whether anyone was misled by these statements in text-books into trying to perform impossibilities. It may be regarded as probable that the medical practitioner, in the presence of post-partum hæmorrhage, grasped the uterus through the abdominal walls, and by exercising pressure and massage succeeded in producing, first contraction and later retraction, of the organ; after some minutes he was able to give directions to the nurse to prepare other means of treatment, and he was himself able in a little while to apply some of them, or, at least, immediately to superintend their application; but he relied chiefly upon the hold which he had of the uterus, and the general experience of the profession was that he did not rely in vain. Within the past few years, however, the practice outlined above has been attacked, and the measures referred to have been characterised as "unscientific and delusive."

Dr. John F. Le Page (*Brit. Med. Journ.*, i. for 1907, p. 185) criticises the routine treatment of post-partum hæmorrhage described in most text-books of midwifery, and adduces the fact that in 1905 there were 619 deaths registered in England and Wales from "flooding," admitting, however, that deaths from placenta prævia were included among the 619 cases. His practice is to compress the abdominal aorta according to the following plan. "I raise the pelvis to cause blood to gravitate towards the heart and brain, and to prevent bleeding from the uterine and ovarian veins. The aorta is compressed to immediately arrest arterial hæmorrhage. The spinal column beneath and below the umbilicus is very prominent and broad, and for the length of 3 or 4 ins. forms an admirable *point de résistance*, for the aorta lies immediately over it. Compression is best made by the outer, the ulnar, portion of the left clenched hand, than which nothing could be more convenient and effective. Pressure should at short intervals be made to slide from one part to another of the available 3 or 4 ins., that no injury be done to the sympathetic system of nerves which forms a network around the vessel, and should be continued until uterine contraction is secured, even if this be delayed for one or two hours. Its release must always be very gradual; the greatest care in this particular is essential. An



important fact is that, although no blood is allowed to pass the compressing hand, there is still a sufficient, but very limited, flow through the ovarian arteries to maintain uterine vitality. I raise the legs and arms to transmit their blood into the trunk, and then bandage them firmly to prevent the return of blood when they are lowered. The effect of this manœuvre is that in many cases a tension of whole blood approaching the normal is attained in one or two minutes. Ergot and other remedial means are at once available. The hand, rendered aseptic, is then very carefully passed into the uterus—first, to detect any possible laceration of the body or cervix or any remaining portion of placenta; and, secondly, to afford a *point d'appui* for grasping and compressing the uterus from outside.” This treatment, Dr. Le Page says, is “rational, always practicable, and so far as his experience goes, unfailing,” and Dr. Bishop (*Practitioner*, lxxviii. pp. 201, 791, 1907) agrees with him regarding the efficacy of compression of the aorta; but their view has not commended itself to all their professional brethren, as a study of the recent literature of the subject shows (*vide* papers by Fitzgerald, Duke, M’Kerron, and others). Le Page attempts to strengthen his argument for compression of the aorta by using the following illustration. “What should we say of a water-department engineer who, when a water main burst, immediately sent for every servant in his employ to attempt to plug the broken pipe? I think a child would say: ‘Turn off the main.’ I have said ‘Turn it off at the main’ for the last quarter of a century. And I say now that this is the one thing which should be immediately done, the one rational initial treatment in all cases of post-partum hæmorrhage. Shut off the current along the uterine arteries by compressing the abdominal aorta. Everything is in favour of this procedure. It is done in a moment; it is done without the smallest difficulty; it is absolutely and instantly effective. Effective in what? In causing the uterus to contract? Certainly not; that is impossible. Effective in immediately restraining the pouring out of blood, which is the one primary indication.” The illustration here employed may, however, be turned round and used effectively in support of the argument for uterine compression, for if a pipe bursts in a private house, the quickest plan to stop the loss is to hammer in the pipe at the break; to turn it off at the main would be to throw every tap in the house out of action. But it is doubtful if the illustration be an apt one in either case. It is more important to remember that bleeding from the interior of the uterus in and after the third stage is naturally checked by the contraction of that organ, which has the effect of applying, so to say, a thousand muscular ligatures to the vessels in the mesometrium; and the effect is maintained between the contractions (which are intermittent) by retraction (which is permanent). It is claimed, therefore, that the right plan to be adopted is to cause contraction of the uterus to check the bleeding and to allow time for retraction to develop; and, unless complete atony, a very rare condition, exist, this result follows the compression, kneading, or massage of the womb. At the same time it may be admitted that some of the many plans of treating post-partum hæmorrhage named in obstetric text-books (*e.g.* the use of ice and of perchloride of iron) are of little or no use, and that compression of the aorta is occasionally of considerable value. Perhaps, however, the most important consideration is the early detection of the commencement of post-partum hæmorrhage by watching the woman



in labour carefully during, not only the third stage, but also the half hour which follows the expulsion of the placenta. The dangerous cases are those in which the first indications of commencing intra-uterine bleeding have been unobserved, overlooked, or neglected; and if the obstetrician will note the state of his patient's pulse and the condition of her uterus with persistent care, he will not often find himself face to face with serious post-partum bleeding. M'Kerron (*Scott. Med. and Surg. Journ.*, xxi. p. 439, 1907) summarises very fairly the whole discussion which has arisen regarding the method of treatment which has been so enthusiastically advocated by Le Page, when he writes: "Although inferior to direct compression of the uterus, pressure on the abdominal aorta is a method which is of undeniable value in post-partum hæmorrhage. In exceptional cases it may be the most readily employed and the quickest means of effecting arrest, but that can scarcely be regarded as a sufficient reason, merely for the sake of uniformity, for attempting to substitute it in all cases for methods which have not only proved their utility and efficiency, but are at the same time in accordance with the natural method and more scientific. The method has, undoubtedly, its value, and it is unfortunate that those who advocate it have taken up the position that it is the only means of arresting post-partum hæmorrhage. They have done good service in emphasising its value, but have gone far towards defeating the object they had in view by their intemperate denunciation of methods which are not only theoretically superior, but which are the outcome of, and have stood the test of, long experience."

If uterine compression be regarded as the method of checking post-partum hæmorrhage which is generally to be preferred, it is essential that it be applied in the best way; and it must be confessed that it is sometimes rendered ineffective by wrongly-directed manipulations. Fritsch (*Deutsche med. Wochensch.*, xxx. p. 19, 1904) has suggested a thorough method of exercising uterine compression in the rare cases in which the excitation of contraction of the womb is almost impossible: the uterus is brought forward in the abdomen by pressing both hands behind it; it is thus forced into an anteflexed position over the symphysis pubis; into the depression behind it towels or pledgets of wool are packed; a binder is then passed round the abdomen and firmly fixed so as to compress the uterus against the symphysis and keep the pads *in situ*; and the binder is allowed to remain on for some hours till the vessels have thrombosed, and the danger has passed away.

LITERATURE.—In addition to the articles referred to above, the following may also be named:—GOSSETT. *Amer. Pract. and News*, xli. p. 407, 1907.—BOECK. *Zeitsch. f. d. ärztl. Prax.*, xx. p. 179, 1907.—CALDERINI. *Lucina*, xii. p. 33, 1907.—CHESTER. *Mass. Med. Journ.*, xxvii. p. 385, 1907.—DE LEE. *Internat. Clinics*, 17 S. ii. p. 147, 1907.—ELLIOTT. *Bristol Med.-Chir. Journ.*, xxv. p. 121, 1907.—HENRY. *Brit. Med. Journ.*, i. for 1907, p. 1362.—HERMAN. *Practitioner*, lxxviii. p. 445, 1907.—STOWE. *Surg., Gynec., and Obstet.*, iv. p. 751, 1907.—TWEEDY. *Practitioner*, lxxviii. p. 361, 1907.—BELL. *Amer. Journ. Obstet.*, lvii. p. 385, 1908.—BROCK. *Practitioner*, lxxx. p. 87, 1908.—ELLIOTT. *Bristol Med.-Chir. Journ.*, xxv. pp. 121, 310, 1907.—WALKER. *New York Med. Journ.*, lxxxvii. p. 164, 1908.—VON WINCKEL. *Deutsche med. Wochensch.*, xxxiv. p. 49, 1908.—GRIFFITH. *Med. Press and Circ.*, N. S. lxxxv. pp. 257, 448, 1908.—PAGGI. *Clin. ostet.*, x. p. 337, 1908.

**Leprosy.**—In the treatment of leprosy Prof. Deycke claims to have obtained remarkable results by the use of injections of nastin,



which is a neutral fat obtained from streptothrix leproides, which was cultivated in pure culture from leprous tissue. By these injections a distinct general and local reaction may be produced. Benzoyl-nastin is said to be superior to pure nastin, and when injected to remove the fat from the leprosy bacillus, which then becomes easily destroyed by the tissues. Until more work is done on the subject a definite opinion cannot be formed of its value, but the results are promising.

REFERENCES.—DEYCKE. *Lepra-Bibliotheka Internationalis*, vii. p. 3; *The Therapist*, 1908, pp. 28, 37; *Brit. Med. Journ.*, 4th April 1908.

**Leukæmia.**—The cause of leukæmia is still as great a mystery as ever. Löwit's theory of its parasitic origin has never received any confirmation, and is now universally abandoned. From the pathological side all observers are agreed that, whatever form the disease assumes, the primary lesion is in the bone marrow. A very great deal has been written about the malady during the past five or six years, and the principal new facts which have been brought out may be considered under the heads of—1. Atypical Forms of Leukæmia; 2. Leukanæmia; 3. X-ray Treatment.

1. ATYPICAL FORMS OF LEUKÆMIA.—It would be wrong to say that the classical distinction between lymphatic and splenomedullary leukæmia has been given up, for the two main types of the disease are so well marked, and in most cases present such characteristic features, that as a matter of convenience they must be retained. There is, nevertheless, a growing body of evidence that they are more closely related than used to be supposed. A number of cases have now been described which do not conform strictly to the classical type, and while it would encroach unduly on the available space to refer to these in any detail, some of the main facts about them may be discussed under the following heads:—

(1) *Leukæmia without Leucocytosis.*—Leukæmia may exist with little or no increase in the total number of leucocytes; it may even be associated with leucopenia. Cases which show this peculiarity are generally of the lymphocytic variety, and in them the differential count will show 90 per cent. of lymphocytes or more. The diagnosis rests on the high percentage of these cells, not on the total number present. An exception to this rule must be made in the case of young children, in whom slight leucocytosis with a high lymphocyte count is normal. In some cases of anæmia in children one finds a great diminution of the red corpuscles and of the granular leucocytes, without affection of the lymphocytes. When this occurs there may be a blood count of (say) 8000 to 10,000 leucocytes with 90 per cent. of lymphocytes. Yet under iron these cases often make a complete recovery. The explanation of the peculiar blood change is to be found in some interference with the function of the marrow, the normal activity of the lymphatic tissues remaining unimpaired. In the adult, however, a lymphocyte count of 90 per cent. or over justifies the diagnosis of leukæmia, irrespective of the total leucocytosis. Low leucocyte counts with a large percentage of myelocytes mostly occur in acute myelocytic leukæmia (*vide infra*) and in cases treated by X-rays.

Cases of lymphatic leukæmia with a low white count have been described as "aleukæmic leukæmia," and as "aplastic leukæmia." Wollf<sup>1</sup> recorded one such in which there was aplasia of the marrow, and states that the diagnosis can be made during life by the associa-



tion of (a) leucopenia, (b) high percentage of large lymphocytes, and (c) progressive severe anæmia without signs of regeneration.

In all doubtful or atypical cases of leukæmia it is essential to calculate the total number of each variety of cell present, as by this means a much clearer conception of the functional activity of the hæmopoietic organs is gained than from the percentages alone (cf. BLOOD, *Clinical Examination*).

(2) *Acute Myelocytic Leukæmia*.—It was formerly held that all acute cases of leukæmia belonged to the lymphocytic group, but this is now known not to be the case. Though lymphocytic forms predominate, acute myelocytic leukæmia does occur. The course and general clinical features of the malady are practically identical with those of the more common lymphocytic form. The degree of the anæmia is considerable; the leucocyte count is usually low, but sometimes rises to a figure comparable to what occurs in chronic cases. The essential change in the blood is the presence of a considerable percentage of neutrophile myelocytes—10 per cent. at least. Eosinophiles may be absent or few; the same applies to an even greater extent to mast cells. Hirschfeld<sup>2</sup> regards absence of eosinophiles and mast cells as characteristic of acute as opposed to chronic myelocytic leukæmia. As in other forms of atypical leukæmia the classification of the leucocytes found is very difficult on account of the presence of aberrant forms; the difficulty is enhanced by the fact that many of them stain badly. It is usually possible to trace a complete series, beginning at the one end with large lymphocytes and ending at the other in neutrophile myelocytes. Normoblasts may be plentiful or absent. In a paper on the subject Billings and Capps<sup>3</sup> give the following as the more important sources of error in diagnosis:—(1) Chronic myelocythæmia with an acute exacerbation. Here the history is of long standing, and the spleen is large, whereas in acute cases it is scarcely palpable in the early stages. (2) Lymphatic leukæmia complicated by leucocytosis. Myelocytes are absent. (3) Acute lymphatic leukæmia with predominance of large mononuclears. Myelocytes are absent. (4) Acute infections causing rapid anæmia with myelocytes and nucleated reds. The leucocyte count is low, and the myelocytes few. (5) Acute exacerbation of pernicious anæmia in which a leucocytosis with myelocytes may occur. (6) Neoplasms invading the marrow.

(3) *Leukæmia Intermediate in Type between the Myelocytic and Lymphocytic Varieties*.—Difficulty in deciding from the blood examination whether a leukæmia should be reckoned as lymphocytic or myelocytic arises under two conditions—(a) A considerable number of cases are now on record in which the blood shows *both* excess of lymphocytes (usually large lymphocytes) and numerous myelocytes. (b) Yet other cases are described in which the blood during one period of the disease was myelocytic, and subsequently became lymphocytic, or *vice versa*.

These intermediate forms, which may, for convenience, be termed “mixed-cell leukæmia,” require some further description. (a) A typical instance of mixed-cell leukæmia of the first group, in a child aged 5, recorded by Fowler,<sup>4</sup> showed the following blood picture:—Red corpuscles, 2,610,000; leucocytes, 240,800, with small lymphocytes, 10·2 per cent., large lymphocytes, 34·4 per cent., non-granular mononuclears (“lymphoid cells”), 15·9 per cent., polynuclears, 16·3 per cent., neutrophile myelocytes, 17 per cent., eosinophiles, ·8 per cent.,



eosinophile myelocytes, 1·1 per cent., mast cells, 4·3 per cent., nucleated reds, 4000 per c.mm. That is to say, here is a case which cannot be reckoned among the lymphocythæmias on account of the myelocytes present, nor to the myelæmias, on account of the large lymphocytes. The total lymphocytes (including small, large, and uninuclears) amounted to 62·5 per cent. In an almost exactly similar case, Findlay<sup>5</sup> found marked leucoblastic hyperplasia of the marrow as in myelocytic leukæmia, and hyperplasia of the lymphatic tissues, as in lymphocythæmia. The most satisfactory explanation of these mixed cases is afforded by assuming (as there is good ground for doing) that the lymphocytes and myelocytes are not genetically distinct, but both arise from a common ancestor. A characteristic feature of mixed-cell leukæmias is the large number of leucocytes which are intermediate morphologically between myelocytes and large lymphocytes; an almost unbroken series of forms links the two, and this renders differential counting far from easy. Wollf and Michaelis,<sup>6</sup> who were among the first to describe such cases, call them "lymphoid-cell leukæmia"; they look on the undifferentiated lymphoid cell (the non-granular uninuclear) as the primitive leucocyte, and interpret the condition as being due to a proliferation of these elements. The term lymphoid cell, however, has been applied to large lymphocytes, and is, therefore, likely to lead to confusion; for this reason, and because it implies no theory, the term "mixed cell" is preferable. Emerson<sup>7</sup> sets out the common-ancestor theory in these words: "It may be that they [*i.e.* myeloblasts or undifferentiated lymphoid cells] are only an early generation of cell which later changes to one of the various granular cells, or perhaps to a red cell. It may be that in myelocytic cases the descendants of these cells which have changed to granular cells are increased; perhaps the disease attacks a different generation of bone marrow cell. . . . It is possible that the relative involvement of these cells is an index of the profundity of the marrow involvement, the myeloblasts preponderating when the marrow lesion strikes at the root of cell genesis, the myelocytes preponderating when the involvement is less fundamental." Muir<sup>10</sup> explains these cases differently. The presence of the myelocytes is "the result of the disturbance of the marrow by the invasion of lymphocytes in a manner analogous to what has been noticed in some cases of tumours implicating the bone marrow. The question whether there is a real mixed-celled leucocythæmia—that is, one where the proliferative process involves the cells both of the granular and non-granular series . . . must be still considered an open one. If such a type occurs it may be due to an involvement of the primitive cell from which both series spring, or to a concomitant affection of the two series." He has not observed a case which requires such an explanation.

(b) *Leukæmia with Change in the Type of Cell Present in the Blood.*—Wilkinson<sup>8</sup> has reported a good example of this. After the patient had been ill for nearly a year the blood was absolutely pathognomonic of advanced splenomedullary leukæmia, the most striking feature being the enormous number of large myelocytes. The lymphocytes were also numerous, there being every gradation between them and the myelocytes. Coincidentally with an acute fatal exacerbation the blood took on the picture of typical large-celled lymphatic leukæmia. Browning<sup>9</sup> has also placed on record a similar case. Ehrlich has suggested in explanation of the change that the "lymphocytes" which appear in the blood in the later stages of the case are merely myelocytes, the granules of which



have ceased to take on the stain, on account of inanition. The explanation, however, is not generally regarded as adequate. Cases of the reverse transformation—lymphocytic into myelocytic—have been reported—*e.g.* by Hirschlaff,<sup>11</sup> but the authenticity of most is questionable. Some are in all probability merely instances of terminal leucocytosis; in others the explanation given by Muir may be correct.

In connection with the diagnosis of leukæmia, and as showing some of the further difficulties in adhering strictly to the older division into lymphatic and splenomedullary, the following points may be noted. Leukæmia may occur without enlargement of the liver, glands, or spleen; the diagnosis always rests on the examination of the blood alone. An apparently unique case of a leukæmic blood picture in a patient suffering from fracture of the ankle is reported by Simon.<sup>12</sup> The fracture was compound, and amputation was required a month after the accident. At this time there was a leucocyte count of 50,000, with 16·2 per cent. of myelocytes, and many normoblasts and megaloblasts. The abnormal appearance soon disappeared, and the patient remained permanently well. One can only account for such a condition by the supposition of temporary hyperactivity of hæmopoiesis resulting from the injury plus septic infection. In whooping-cough the leucocytosis is often very great, especially when the disease is complicated by pneumonia or capillary bronchitis. Leucocyte counts of over 100,000 have been reported by Crombie,<sup>13</sup> and the blood has a superficial resemblance to that of leukæmia. No abnormal cells, however, occur; the phenomenon is of diagnostic importance, particularly in young infants, for in them the characteristic whoop is often absent, especially if a pulmonary complication is present.

2. LEUKANÆMIA.—The hybrid term “leukanæmia” was coined by Leube in 1902 to describe the case of a child aged 10, who died of profound anæmia lasting only three weeks. The blood changes and post-mortem findings were a combination of those usually observed in leukæmia and pernicious anæmia. The condition is an ill-defined one, but similar cases have now been described by Hurter,<sup>14</sup> Weber,<sup>15</sup> Drysdale,<sup>16</sup> and others. In Leube’s patient the liver and spleen were enlarged; the red cells were reduced to 256,000, the whites numbered 10,600, the colour-index was 2·0. There were megaloblasts and normoblasts, and 13 per cent. of myelocytes. Post mortem there was myeloid transformation of marrow and spleen, and no siderosis of the liver. Drysdale, whose case was very similar, has collected reports of 11 other cases, and points out that in all save one siderosis of the liver has been absent. This suggests a primary megaloblastic degeneration, not hæmolysis, as the cause of the anæmia. The leucocyte count is not low in all cases; the pathological appearances are not inconsistent with the diagnosis of leukæmia. Drysdale is of the opinion that the majority of the cases described as leukanæmia properly belong to the group of atypical myelocytic leukæmias, and certainly the balance of evidence seems to point in this direction rather than in favour of a combination of two such definite pathological entities as pernicious anæmia and leukæmia.

3. X-RAY TREATMENT OF LEUKÆMIA.—The earliest cases of leukæmia treated by the Röntgen rays were reported in America, and the credit of priority in the introduction of a remedy which, though not curative, is yet more likely than any other known to us to prolong life and mitigate suffering, belongs to Pusey and Senn, who in 1903 and 1904



first brought the subject under the notice of the medical world. Since that time the treatment has been very extensively tested, and its value can now be estimated with fair accuracy.

Röntgen rays do not cure leukæmia permanently; in many cases, nevertheless, splenic and glandular enlargements subside, the blood becomes practically normal, and the patient enjoys a period of respite from symptoms which may be of very considerable duration. The following tables, compiled by Pancoast,<sup>17</sup> give the results of 123 cases treated between 1901 and 1906:—

	Splenomedullary.	Lymphatic.	Unclassified.
Symptomatic cure . . . . .	33	11	3
Improved . . . . .	22	8	1
Improved ; still under treatment	14	1	0
Unimproved . . . . .	13	0	3
Unknown . . . . .	1	0	2

The final results in 63 cases are:—

Still living and well . . . . .	2	2	0
Symptomatic cure, fatal relapse .	11	5	0
Symptomatic cure, serious relapse	5	0	0
Improvement, fatal relapse . . .	14	3	1
Unimproved, died . . . . .	5	8	3
Relapsed and under treatment . .	4	0	0

The duration of symptomatic cure varies. Though it often lasts but a few months, four patients, at least, are reported as alive and well three, four, and six years after treatment. Myelocytic leukæmia appears to respond more readily than the lymphocytic type, and patients suffering from the acute form of the disease are more likely to derive harm than good from the treatment.

*Technique.*—A hard tube should be used, as being more penetrating in its effect, and less likely than a soft tube to cause dermatitis. The sittings should be brief, from three to ten minutes thrice a week or oftener. Exposures should be made over the spleen, enlarged glands, and bones, particularly the ribs and sternum. Neighbouring parts may be protected by lead shields.

*Effect of the Rays on the Hæmopoietic Organs and Blood.*—As a rule the spleen becomes softer and diminishes in size after a few exposures. In many cases it speedily returns to normal dimensions; in a few instances, however, even repeated applications have produced no effect. Enlarged glands become smaller, though the change in them is less marked than in the spleen. Tenderness of the bones disappears. The general effect on the blood is to produce a steady diminution in the leucocytes. There is, it is true, a temporary rise of short duration, due, in all probability, to the profound changes in the lymphoid tissues causing a flooding of the blood with white cells; but this is followed by a speedy fall, which may amount to nearly 200,000 per c.mm. after a single exposure. Generally, however, the diminution is more gradual—perhaps 20 or 30 exposures spread over 5 or 6 weeks being required to bring the leucocytes down to an approximately normal number. The leucocytes, moreover, are altered qualitatively as well as quantitatively, the abnormal elements practically disappearing. Arneth and others have worked out the changes which occur. The lymphocytes,



particularly the larger forms, steadily diminish; the neutrophile myelocytes dwindle and may vanish altogether, while the polynuclears correspondingly increase. Mast-cells fall, while the eosinophile group becomes normal. There is, at the same time, a rise in the red corpuscles, and a disappearance of abnormal forms. Broadly, then, the effect of the rays is to produce an aleukæmic phase. Myelocytes are more susceptible than lymphocytes, and in lymphocythæmia, though the count may become normal, the percentage of lymphocytes usually remains high.

With the symptomatic cure the general health improves correspondingly; relapse, sooner or later, inevitably occurs, and the treatment must be repeated with, on the whole, less prospect of success than before. Satisfactory on the whole, considering the nature of the malady, as Röntgen rays are, the treatment is not devoid of risk. The rapid destruction of large numbers of leucocytes must be associated with the liberation of products of their disintegration, and it is not surprising that some cases of fatal toxæmia have been reported. Sudden death has occurred from this cause in not a few instances, and in some of these nephritis has been found. Treatment, therefore, should not be instituted unless the kidneys are sound, nor if there is any evidence of toxæmia. A moderate degree of pyrexia does not contra-indicate raying, but if the temperature is inclined to rise after exposure, it is probably safer to desist. The patient should be kept in bed during the early days of the course of treatment, until it is certain that the rays are doing no harm. At first the exposure should not exceed 3 minutes, and it should not be repeated for 3 or 4 days, until it is seen whether any reaction is going to occur. The action of the rays continues after the rays themselves have been stopped; it may sometimes be observed that glands which have begun to soften progressively diminish in size for several weeks later. The immediate effect of the rays on enlarged glands is sometimes to produce a temporary swelling and hardness, accompanied by a feeling of local discomfort or even pain. These symptoms, however, are of short duration. Cases of acute leukæmia should not be treated with X-rays. Among minor inconveniences, dermatitis, palpitation, vomiting, and diarrhœa have been reported.

*Nature of the Action of X-rays.*—Theoretically, the fall in the leucocytes produced by the rays might be due either to lessened production or stimulation of leucolysis. In animals subjected to the action of the rays, Heinecke,<sup>18</sup> whose work has been confirmed and is generally accepted, found marked evidence of destruction of the lymphocytes throughout the body—in the splenic pulp, marrow, glands, and follicles of the intestine. The process begins within 3 hours of exposure, and is complete in from 36 to 48 hours. Probably the circulating leucocytes are also destroyed. The red corpuscles, on the contrary, resist the action of the rays. The destruction of the lymphoid tissue is always more marked in the spleen than in the glands or marrow. Young forms of cell—myelocytes and lymphocytes—are most affected. Regeneration is slow after prolonged or repeated exposure (Warthin<sup>19</sup>). The diminution of leucocytes is accompanied by an excessive output of urinary phosphorus and nitrogen.

Warthin's final conclusions are, that improvement is more marked in cases seen early; that lymphatic cases require more energetic treatment than myelocytic; that the prolonged action of X-rays is due to a leukolytic toxin formed in the serum; that X-ray treatment should be



combined with arsenic; that no permanent cure has ever been effected.

X-ray treatment has also been employed in *pseudoleukæmia*, with results which are said to be better than in leukæmia, for about a quarter of the patients remain alive and in good health for three or four years; in polycythæmia without benefit; and in pernicious anæmia. In the last-named disease the liability to the occurrence of toxæmia, and the frequency with which the kidneys are diseased, contra-indicate this line of treatment.

LITERATURE.—The literature is extensive. Many of the references in the text give bibliographies on special subjects. General literature is regularly abstracted in *Folia hæmatologica*, which is an invaluable source of reference in all blood diseases. 1. *Berl. klin. Wochensch.*, p. 35, 1905. 2. *Ibid.*, 24th June 1907. 3. *Amer. Journ. Med. Sci.*, Sept. 1903. 4. *Internat. Clinics*, ser. 13, vol. iii., 1903. 5. *Glas. Med. Journ.*, 1907. 6. *Zeitsch. f. klin. Med.*, lxxv. pp. 87, 411, 1902. 7. *Johns Hopkins Hosp. Bull.*, March 1907. 8. *Lancet*, 20th July 1903. 9. *Ibid.*, 19th Aug. 1905. 10. *Glas. Med. Journ.*, Sept. 1905. 11. *Centralb. f. inner. Med.*, p. 836, 1898. 12. *Amer. Journ. Med. Sci.*, Sept. 1907. 13. *Edin. Med. Journ.*, Sept. 1908. 14. *Liverpool Med. Journ.*, Jan. 1907. 15. *Trans. Path. Soc., London*, lx., 1904. 16. *Quarterly Journ. Med.*, Oct. 1907. 17. *Univ. Penn. Med. Bull.*, 1906. 18. *Münch. med. Wochensch.*, No. 48, 1903. 19. *The Physician and Surgeon*, Jan., Feb., March, 1907 (full references to X-rays).

**Lumbar Puncture.**—(See also *Encyclopædia Medica*, Vol. XI. p. 329.)—Lumbar puncture is now fully recognised as a legitimate and valuable diagnostic procedure. It is simple, practically devoid of danger, and often gives information of the greatest possible worth.

TECHNIQUE.—In the adult the spinal cord terminates at the lower part of the first lumbar vertebra. Lumbar puncture is performed between this point and the upper sacral vertebræ, the site usually selected being between the third and fourth or fourth and fifth vertebræ. The position is easily determined by drawing a transverse line at the level of the highest point of the iliac crest, and puncturing below the spinous process which this line intersects—the fourth lumbar. The needle used should be about three inches long; it may be one of platinum and iridium specially made for the purpose, but an ordinary exploring needle answers perfectly well. It must be provided with a wire stylet to clear it if it becomes blocked. It is convenient to have the needle mounted on a syringe, which serves as a handle. The needle should be boiled before use, and the skin of the patient should be thoroughly purified with lysol and ether. In performing lumbar puncture it is important to have the patient's spine flexed; in cases of meningitis this may necessitate the use of a general anæsthetic; otherwise anæsthesia is not required. In children, lumbar puncture may be performed as the patient lies in bed, the body being held in the flexed position by the hands of an assistant, one of which controls the head, the other the pelvis. In adults the operation may be performed with the patient either in the recumbent or stooping posture. The needle should be introduced in an interspace rather to one side of the middle line, and pushed steadily forwards with a slight inclination upwards and inwards. The most common error is to direct the point too much up and in. The tissues through which the needle has to pass are somewhat dense, and it is generally easy to feel when the point has entered the subarachnoid pond. In place of introducing the needle laterally the middle line may be selected and the puncture made directly forwards and slightly upwards. When the needle is felt to have entered the sub-



arachnoid space the syringe is removed to allow the fluid to escape. If none flows out the stylet should be passed to clear the needle, and if this manœuvre fails, the needle may be pushed in a little farther, lest it should not actually have entered the spinal canal, or *very gentle* suction may be made with the syringe. As a rule the fluid drops out freely, and may be collected in a sterile tube. The first few drops should be rejected, lest they be accidentally contaminated with blood.

EXCEPTIONS.—1. "*Dry Taps*." It is sometimes impossible to withdraw fluid by lumbar puncture. The reason for this is not always apparent. In some cases it is due to occlusion of the channels between brain and spinal canal. In commencing hydrocephalus from meningitis a "dry tap" is a bad sign for this reason. 2. *Hæmorrhage*. If the fluid is blood-stained, cytological examination is useless. The fluid may be hæmorrhagic either because of a cerebral hæmorrhage, or, much more commonly, from wound of one of the subarachnoid veins. This is most likely to occur if the needle is thrust in too far, and impinges against the venous plexus on the bodies of the vertebræ. Dangerous hæmorrhage into the spinal canal may occur in this way. 3. *Injury to Cauda Equina*. If a trunk of the cauda equina be touched, the patient may complain of pain shooting down the legs. Headache may follow the operation. Lumbar puncture, however, is a very safe proceeding; hæmorrhage is the only real danger, and this can to a large extent be prevented by not making the puncture too deep.

QUANTITY OF FLUID WITHDRAWN.—In most cases it is sufficient to withdraw 5 or 10 c.c. of cerebro-spinal fluid. When the fluid is under great pressure it may be allowed to escape until the pressure falls. In infants the effect which is being produced may be judged of by noting the fall in the tension of the anterior fontanelle. It is undesirable to withdraw more fluid than is necessary, as temporary collapse may occur.

CEREBRO-SPINAL FLUID.—The cerebro-spinal fluid is a secretion, probably from the choroid plexus, not an exudation (Mott). Normally, it is a perfectly limpid fluid containing no true albumin or fibrinogen; it yields traces of a Fehling-reducing body, not sugar. It has a specific gravity of 1006-1008, is sterile, and is practically free from cells. From a diagnostic point of view the physical characters, chemical characters, bacteriology, and cytology of the fluid have to be considered; the last is the most important.

1. *Physical Characters*.—(1) *Pressure*. Normal fluid emerges from the needle in drops at the rate of 2 to 3 per second; in pathological conditions it may drop out more rapidly, flow out in a continuous stream, or even spurt out in a jet of some length. It is not difficult to judge from observing the rate of flow whether or not the fluid is under pressure, and the knowledge so gained is sufficiently accurate for practical purposes. The pressure can, however, be measured easily enough. A glass tube about 18 ins. long, with a bore of about  $\frac{1}{16}$  in., is connected by an inch of rubber tube to the needle, and the height to which the fluid rises when the tube is held upright, is measured. The normal pressure is about 125 mm. H<sub>2</sub>O; in disease (*e.g.* tuberculous meningitis) it may rise to 700 mm. or more. The chief information obtained from estimations of the pressure is in cases of hydrocephalus following meningitis. If the pressure is high, the foramen of Magendie must be patent; if it is low, there is probably an occlusion between the base of the brain and the spinal canal. (2) *Colour*. The fluid is usually perfectly limpid, and deposits no coagulum on standing. In acute



cerebro-spinal or pneumococcal meningitis it is turbid or even purulent; in chronic cerebro-spinal, post-basic, and tuberculous meningitis, especially the last, it may be almost clear, though as a rule a faint opalescence can be made out. Even the perfectly clear fluid of tuberculous meningitis often deposits a fine coagulum on standing. The fluid is blood stained in many cases of hæmorrhage into the central nervous system. Estimations of the specific gravity, freezing-point, and electrical resistance are useless.

Thus mere physical examination yields much definite information. Turbidity is proof of meningitis, and even the slightest haziness is highly suspicious. Perfectly clear fluid negatives all forms of meningitis except tuberculous, and if the fluid is both clear and under no increase of pressure, there is probably no meningitis.

2. *Chemical Examination*.—Albumin may be estimated in a small-sized Esbach's tube. A quantity exceeding .5 gram. to the litre is pathological; it has much the same significance as excess of cells. In general paralysis of the insane, Guillan and Paraut describe the following reaction:—"When normal cerebro-spinal fluid is boiled, the albumin coagulates, and the fluid becomes slightly opalescent. If the globulin be precipitated by adding a saturated solution of magnesium sulphate, the fluid filtered, and the filtrate again boiled, it should remain clear. In general paralysis, however, the second boiling yielded a characteristic precipitate in every case out of a series of 16 general paralytics examined by these observers" (Purves Stewart). In 1899 Mott and Halliburton described cholin in the cerebro-spinal fluid in cases of degenerative diseases of the nervous system, and suggested that its presence might serve to differentiate between organic and functional disorders. The cholin is crystallised out as a cholin-platinum chloride. The test is too complicated for clinical use, and, moreover, there is considerable doubt as to the nature and reliability of the reaction. Donath (*Rev. Neurologique*, 16th Feb. 1906) has introduced a modification of the test, and states a positive result is given in epilepsy as well as in degenerative diseases. Kaufmann (*Neur. Zentralb.*, 16th March 1908) thinks that the reaction has no clinical significance. The Fehling-reducing body is said to be absent in cases of tuberculous meningitis. At least 10 c.c. of fluid are required to test for its presence.

3. *Bacteriology*.—Among the organisms which, when present, are easily detected in ordinary smears, meningococci, pneumococci, and strepto- and staphylococci are the most common. It is difficult to detect tubercle bacilli; they should be sought for in the small coagulum which forms in the fluid from tuberculous meningitis. Much patience is required to discover them; some diligent workers state that they can be found in nearly 100 per cent. of cases; others have been less fortunate. Stuart M'Donald has recently demonstrated a leptothrix in some cases of meningitis.

The Wasserman test and other immunity tests may be applied to cerebro-spinal fluid (see IMMUNITY DIAGNOSIS). The cerebro-spinal fluid of the great majority of cases of general paralysis gives a positive Wasserman reaction.

In cases of sleeping sickness the trypanosoma gambiense is found in the cerebro-spinal fluid.

4. *Cytology*.—Normal fluid contains few or no cells. The cellular contents of the fluid may be estimated in several ways:—(1) Centrifuge about 5 c.c. of fluid for 10 minutes, pour off the fluid and remove the



tiny clot at the foot of the tube with a platinum loop. Spread this on a clean slide over an area of 5 mm.<sup>2</sup>, fix, and stain. By always adopting the same routine the number of cells per field gives an index of the cellular content. Normally, there should not be more than one or two per field of an oil-immersion lens. (2) Count the cells in an ordinary Thoma-Zeiss blood-chamber. The fluid over the whole ruled area ( $\frac{1}{10}$  mm.<sup>3</sup>) in 5 successive preparations must be counted. From 1 to 5 cells per cubic millimetre is normal, 5 to 9 doubtful, 10 and over, pathological. This is the easiest and most accurate method. It is unnecessary to stain or dilute the fluid; all that has to be done is to place a drop on a well-cleaned slide, to cover, and to examine. In tuberculous meningitis one commonly finds from 10 to 30 cells in each preparation, *i.e.* 100 to 300 per cubic millimetre. When they are numerous it is not necessary to examine more than one drop of fluid. (3) A third method, specially adapted for careful study of the cells, is unnecessarily elaborate for clinical work. Some fixing agent, *e.g.* alcohol, is added to the cerebro-spinal fluid, which is then thoroughly centrifuged. The deposit is embedded in celloidin, and sectioned. Cotton and Ayres have worked out the details of this method. The standard taken for comparison is the number of cells per 100 oil-immersion fields. They describe the following varieties of cells:—(1) Lymphocytes, including forms transitional between these and plasma cells. (2) Endothelial cells, large, oval, with horse-shoe nuclei. (3) Phagocytes. (4) Plasma cells—pathognomonic of general paralysis. (5) “Körnchen” cells, containing droplets of fat. (6) Polynuclear leucocytes.

The chief directions on which diagnostic information can be derived from a study of the cytology of the cerebro-spinal fluid are as follows:—

1. *Tuberculous Meningitis*.—Cells are fairly abundant; in round numbers from 40 to 700 per c.mm. The average in Rous's cases was 213. Both mononuclear and polynuclear forms occur; there is a tendency to lymphocytosis, but the ratio between the two forms is not of importance.

2. *Acute Meningitis, Pneumococcal, Meningococcal, etc.*—Marked polynuclear leucocytosis.

3. *Other Nervous Diseases, excluding Syphilitic and Parasyphilitic Lesions*.—In serous meningitis (Quincke) the fluid is sterile, the pressure is slightly raised, and there may be a few lymphocytes. In hæmorrhagic meningitis, cerebral hæmorrhage, etc., blood may be present. In poliomyelitis, cerebral tumour, meningism, and the majority of other diseases, cytological examination is negative. The pressure may be raised.

4. *Lymphocytosis* occurs in practically all syphilitic affections, in tabes, and in general paralysis. In the last named, Cotton and Ayres describe lymphocytes, plasma cells, and sometimes phagocytes as pathognomonic of the disease.

5. In *non-nervous diseases* the findings are negative.

6. Generally speaking, *lymphocytosis* points to an organic affection of the meninges, especially tuberculous or syphilitic; it may therefore occur now and again in cases of cerebral tumour. In any old-standing disease of the nervous system “Körnchen” cells may be found (Cotton and Ayres).

7. In *mental diseases*, other than syphilitic, the fluid contains no cells.

**THERAPEUTIC USE OF LUMBAR PUNCTURE.**—Lumbar puncture is



often effective in relieving headache due to intra-cranial pressure, *e.g.* from cerebral tumour. Care must be taken to drain the fluid off slowly, lest a sudden lowering of the pressure produce hæmorrhage into the tumour. Lumbar puncture may also be tried in cases of obstinate tinnitus, in coma from fracture of the base of the skull, in uræmia, and in convulsions. Tetanus has been treated by the injection of antitoxin into the spinal or cranial cavity, and strychnine poisoning by the intra-spinal injection of eucaine (see also CEREBRO-SPINAL MENINGITIS, p. 112, and ANÆSTHESIA, SPINAL, p. 33).

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**Lupus Erythematosus.**—Although we are still in the dark as to the etiology of lupus erythematosus, some advance has recently been made in its treatment.

**FINSEN LIGHT.**—In chronic cases, after soothing local treatment has been tried unsuccessfully, exposures to the Finsen light are found to be beneficial. As suggested by Norman Walker, the exposures are given at a distance of about a foot from the lens of the lamp on every alternate day for half an hour. In this way a comparatively large area may be treated at one time, and the difficulty of applying the compressor, which is used in treating lupus vulgaris, done away with. At the same time as the light treatment is being given, the patient should also use some soothing lotion night and morning.

**X-RAYS.**—X-rays have been tried in lupus erythematosus with varying results. The seborrhœic form of the disease is the one which is most benefited by rays, but as considerable exposures have to be given there is a risk of producing a local reaction with a subsequent atrophy and telangiectasis. Recurrence of the disease after its removal by X-rays is also not uncommon. Taking into account the risks of the treatment, the uncertainty of the result, and the tendency to relapse, X-rays cannot be said to be better than other methods of treatment, and therefore other less dangerous methods have to be preferred.

**FREEZING.**—Another method which has given good results is that of freezing the skin. This was first introduced by Arning, who sprayed a mixture of ethyl and methyl chloride on the skin till it was frozen. Later Juliusberg attained the same object, but got a deeper and more rapid effect, by allowing liquid CO<sub>2</sub> from a cylinder to jet on the skin. The difficulty of controlling the escape of the CO<sub>2</sub> was overcome by Pusey, who allows the carbon dioxide to escape with a rush from the cylinder into a piece of chamois leather. It deposits on the leather in the form of a snow which can be compressed into solid masses, which are cut into shape with a knife, grasped by forceps, and applied to the skin. The snow may also be stamped out into pencils of convenient shape and size by means of an ear speculum or cylindrical rubber tube of different widths. The snow is pressed into the lesion for a half to one minute. The longer the contact and the firmer the pressure, the deeper the freezing. The skin is thus frozen to a depth of about half-an-inch. The freezing is absolutely painless, and the subsequent thawing causes only a slight stinging sensation, which soon passes off.



A few moments later a wheal begins to develop, and later the affected part shows a circumscribed inflammatory reaction with vesiculation. Later this crusts over, and when the crust falls off the lesion has disappeared without any visible scar formation.

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**Lupus Vulgaris.**—FINSSEN LIGHT.—The Finsen light treatment of lupus vulgaris is undoubtedly the method of choice where a good cosmetic result is desired, but the expense and time necessary for the treatment are beyond the means of many patients. After the light treatment, cases must be kept for some time under observation, as recurrences are not uncommon, because the deeper nodules are not readily accessible to the rays, and the disease heals on the surface but reappears, starting from some deep nodule which has been overlooked. In the Edinburgh Royal Infirmary the Finsen light treatment has been almost entirely replaced by the X-rays.

X-RAYS.—The rays should be given regularly for a period and then stopped, as the disease continues to heal for weeks and sometimes months after X-ray treatment has been discontinued. A combined method of treatment gives the best results. X-rays alone are not advisable. Locally a very good application is an ointment consisting of Ichthyolici  $\mathfrak{M}$ xv., Ac. salicyl. gr. x., and Ung. hydrarg. oleat. (5 per cent.),  $\mathfrak{z}$ i. This ointment should be rubbed very well into all the nodules for at least half an hour, night and morning. The advantage of this ointment is that the patient can use it himself at home for an indefinite time without supervision. Combined with simultaneous X-ray exposures very rapid results may be obtained.

DREUW'S METHOD.—For those who cannot obtain X-ray treatment, a useful method is that introduced by Dreuw. This method consists in first freezing the diseased area by ethyl chloride or carbon dioxide snow, and then rubbing crude hydrochloric acid well in. Pieces of wood with cotton-wool wound round the end are dipped in the hydrochloric acid, which is very thoroughly rubbed in. The acid has a selective action on the lupus tissue, causing it to slough off. After the acid is applied, the area is dressed with a bland powder. A crusted slough forms, and when that falls off the resulting scar is a good one. For large areas it is recommended to give the patient chloroform, as the treatment can thus be much more thoroughly carried out. This method is suitable for lupus of the mucous membranes as well as of the skin. Dreuw claims that the preliminary freezing makes the operation practically painless, but that is not the case, the pain, although of short duration, often being very considerable. The cauterisation has to be repeated as often as necessary. After the greater part of the disease has been cured, any isolated nodules, which are left, are spiked with the crude acid, which is introduced by a small sharp-pointed glass tube. The advantages of the method are its cheapness, rapidity of action, and good cosmetic result.

TUBERCULIN.—Tuberculin (T. R.) has now been used fairly extensively in the treatment of all tuberculoses of the skin, but the results



recorded are very various. Some claim to have cured the disease with tuberculin alone, but the majority report improvement only in certain cases, the dry scaly forms without ulceration being least affected by tuberculin.

Tuberculin (T. R.) may safely be given in doses of  $\frac{1}{2000} - \frac{1}{1000}$  mgm. every three weeks, and the counting of the opsonic index is not essential. The effect on the disease and on the general condition should be watched, and if these improve the injections continued. The injections should not cause any rise of temperature or local reaction in the diseased area. Tuberculin treatment should be combined with local treatment, such as X-rays, etc.

The use of old tuberculin (A. T.) is now entirely reserved for diagnostic purposes in doubtful cases. It is given subcutaneously in an initial dose of  $\frac{1}{10}$  mgm. This usually causes a rise of temperature and a marked local redness and swelling of the lesions. The local reaction is the only reliable one, as the general reaction may be due to tubercle of the internal organs. It should also be remembered that a rash not infrequently follows the injection of old tuberculin. The rash is usually a small papular one, and often indistinguishable from lichen scrofulosorum. It has no significance, and fades as a rule in a few days, but may persist as a chronic eruption like lichen scrofulosorum.

CALMETTE'S AND PIRQUET'S REACTIONS.—The ophthalmic tuberculin reaction and Pirquet's cutaneous tuberculin reaction are of no value in the diagnosis of skin diseases. If a positive result be obtained, it is simply an indication that the patient has either active or latent tuberculosis in his body somewhere, and does not imply that any skin lesion present is tuberculous in nature.

RADIUM.—Radium is also useful in the treatment of lupus. The duration and frequency of the applications depend on the quantity of radium used, and can only be learned by experimenting with a given specimen of radium. Its action is very much like X-rays, but it has the further advantage that it can be applied to the mucous membrane of cavities, such as the nose and mouth, where it is difficult or impossible to apply X-ray treatment. It can also be readily applied to lesions which are in close proximity to the eye. The disadvantages are the high price and its applicability to only limited areas at a time.

REFERENCES.—MORRIS and DORE. *Light and X-Ray Treatment of Skin Diseases*, 1907.—DREUW. *Berl. klin. Wochensch.*, No. 17, 1904.—REYN and PETERSEN. *Lancet*, p. 1004, 1908.—RAW. *Lancet*, p. 481, 1908.—LOW. *Scott. Med. and Surg. Journ.*, May and Sept. 1905.

**Mediterranean Fever—Malta Fever.**—The work of the Mediterranean Fever Commission, appointed in 1904, has thrown a great deal of light on the nature of this disease, which is due to the *micrococcus melitensis* described by Bruce in 1886. In 1897 Wright showed that the blood of Malta fever patients contained specific agglutinins. The chief results of the commission's work are as follows:—

1. *M. melitensis* is a vigorous organism which may resist desiccation for a period of several weeks.

2. Malta fever is a septicæmia; the specific organism can be recovered from the peripheral blood of the patient, from the urine, and from the fæces.

3. An ambulatory type of the disease exists among the inhabitants



of the island. Infected persons give the agglutination reaction, have the micrococci in their blood, and excrete them by the urine.

4. Infection is not conveyed by the sputum, sweat, breath, or scrapings of the skin of patients. It does not take place "if contact is limited to skin surfaces only, and if contamination with infected excretion is carefully eliminated" (Eyre). Infection is probably occasionally conveyed by sexual intercourse.

5. The disease can seldom be induced in monkeys by exposing them to infected dust.

6. About 50 per cent. of the Maltese goats give a positive agglutination reaction, and about 10 per cent. excrete milk which contains the *micrococcus*. By feeding goats on infected material it is, in many cases, possible to produce the disease in them. Monkeys fed on infected milk contract the disease.

7. A steamer conveying infected milch goats to Antwerp became the seat of an epidemic. Of 10 individuals who drank freely of the milk on board 8 fell sick of Malta fever. Attempts to inspect the milch goats on the island led to a strike among the dairymen, which necessitated the replacement of the goats' milk in the dietary of the troops by condensed milk: Malta fever at once diminished. In 1905 there were 750 cases; in the first half of 1906, 144 cases; second half of 1906 (after alteration of milk supply), 32 cases; 1907, 7 cases. In the navy during 1905 there were 498 cases; during 1906, 248 cases; January to September 1907, no cases. These observations in the epidemiology of the disease have been confirmed by investigations showing that, in the majority of cases of the disease, a direct relationship with fresh milk can be traced. The goat is probably the primary source of the disease in most, if not all, cases.

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Menstruation.

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SINCE the appearance of the *Encyclopædia Medica* the most important advance in our knowledge of *menstruation* has been in the direction of the elucidation of its comparative physiology. W. Heape's article (*Quarterly Journ. Microsc. Sc.*, xliv. p. 1, 1900) may fairly be said to have inaugurated a new series of investigations which have been of the greatest value in breaking down the artificial wall of separation which had been built up between menstruation in the human female and that process in other mammals. Heape began with a revision of the current terminology of the subject. He defined the "reproductive period" as the whole period of the life of a mammal (male or female) during which its generative organs were capable of the reproductive function; the "breeding season" was the whole of the consecutive period during which any male or female mammal was concerned in the production of young, and it did not include (in the case of the female) the nursing period, although it did include the "sexual season" and gestation; and the "sexual season" was for both male and female mammals the



particular time, or times, in the year during which their sexual organs exhibited special activity, and it might consist of one or more periods, long or short, interrupted or not by gestation (in the female). It was desirable to restrict the terms "rutting season" and "rut" to the phenomena of reproduction in male mammals; but "rutting season" might be regarded as synonymous with the "sexual season in the male." In some mammals, such as the stag, the rutting season was a limited and defined period of the year, during which alone the male had power of inseminating the female; in others, such as the dog, there was sexual capability all the year round. Having in this way simplified and defined the terminology of the subject, Heape proceeded to deal with the female sexual season and its phenomena, especially as they were manifested in the absence of the male, for his presence, and more particularly the occurrence of gestation, introduced complications. He found that the sexual season consisted of four consecutive periods. In the case of mammals (*e.g.* the bitch and wolf) which are named "*monœstrous*," the four periods were as follow:—(1) there was the pro-œstrum, or "coming in season," during which the internal and external genital organs showed congestive and hypertrophic changes and exhibited a discharge, generally mucous in character, but sometimes containing blood also; (2) this was followed by the "œstrus," the climax of the whole cycle, and the time during which the female had desire for the male and was capable of being fertilised by him; as a rule œstrus succeeded the pro-œstrum, and during its occurrence the wave of vascular disturbance which had affected, in turn, the external and the internal generative organs passed back again to the external parts; (3) a period ("met-œstrum") during which the functional activity of the organs was subsiding, followed upon œstrus; and (4) "an-œstrum" or the anœstrous period, a resting time during which the reproductive organs lay fallow, so to speak, brought the whole cycle to a close. A "monœstrous" mammal might have one, two, or three such *anœstrous* cycles in a year, thus (representing the periods by their initials) there might be P:Œ:M:A (of ten or eleven months); or P:Œ:M:A (of two or three months): P:Œ:M:A (of two or three months).

But there was also another type of sexual season, such as was met with in the mare. In that type there occurred the pro-œstrum, œstrus, and the metœstrum as in monœstrous mammals; but then followed, not *anœstrum* but a short resting time called "*di-œstrum*," and then the cycle recommenced (pro-œstrum, œstrus, metœstrum), to end this time in anœstrum, or, perhaps, once more to have diœstrum and a third cycle. The sexual season consisted of a series of such cycles, which might be termed *diœstrous*, and the mammal which had this type of sexual season was called "*polyœstrous*." The human subject had this diœstrous type in so exaggerated a degree that, during her whole reproductive life, she never had anœstrum at all; there was a continuous series of diœstrous cycles, and she had a sexual season which (in the absence of gestation) was coterminous with her reproductive period. There were ethnical traces, however, of a time in the development of the human race when the series of cycles had been broken by anœstrous periods, and at the present day there was some evidence that Esquimaux women had such occasional resting periods. It was possible, therefore, to regard the polyœstrous type as a concentration of several monœstrous sexual seasons; on the other hand, it could be argued that the monœstrous type was a decentralised poly-



œstrum. Of course the occurrence of conception, of gestation, and of the suckling period interfered with the symmetry of these cyclical processions; the mammal which became impregnated then had a pro-œstrum and œstrus, followed by gestation and parturition, and, after that, passed through what was left of an anœstrous period, or entered at once into another œstrus and another gestation. The cause or origin of the sexual season was difficult of determination, but there was some evidence that a nutritional stimulus had something to do with it; at any rate the special feeding (the so-called "flushing") of ewes hastened the appearance of the sexual season in them.

Having cleared up the comparative physiology of the sexual season for mammals, Heape proceeded to fix the position of menstruation in the human female and the primates with regard thereto. He identified menstruation with the pro-œstrum; and he pointed out that in both there was congestion and growth followed by destruction of tissue, in both there was recurrence, and that the phylogeny of the subject indicated this identification. The difficulty which was presented by the absence of the discharge of blood in most mammals, and by its presence in the primates, was capable of explanation. There were gradations between the mammals in which the discharge consisted of mucus with a few epithelial cells and those in which it was made up of blood and some of the uterine stroma. Again, the absence of an external discharge of blood was not necessarily indicative of the lack of intra-uterine hæmorrhage, for in certain cases blood was undoubtedly extravasated into the uterine cavity, to be re-absorbed or expelled as a clot. Heape, therefore, not only showed the analogies between the sexual season in mammals and the reproductive processes in the human female, but also brought menstruation, as it occurs in the primates, into line with analogous phenomena in other mammals, identifying it with the pro-œstrum or period of "coming in season," or "in heat."

It was not long before other observers followed the path of investigation and research which Heape had entered upon; and Francis Marshall (*Proc. Roy. Soc. Lond.*, lxxi. p. 354, 1903; *Phil. Tr. (Lond.)*, cxcvi. p. 47, 1904; *Quart. Journ. Microsc. Sc. (Lond.)*, xlviii. p. 323, 1904-5; *Internat. Clin. (Phila.)*, 17 s., ii. p. 190, 1907), Marshall and Jolly (*Proc. Roy. Soc. Lond.*, s. B., lxxvi. p. 395, 1905; *Proc. Physiol. Soc. Lond.*, p. xxvi., 1906), and Emrys-Roberts (*Proc. Roy. Soc. Lond.*, s. B., lxxvi., p. 164, 1905) all made important contributions to our knowledge of the comparative physiology of the sexual season by their inquiries into the œstrous cycle in the sheep, the ferret, the bitch, and other mammals. The œstrous cycle of the lower mammals was to be regarded as homologous with the menstrual cycle of monkeys and the human female, for similar histological changes occurred in the uterus and external genital organs during these cycles. While, however, the changes were essentially similar, there were differences in detail: thus the destruction of uterine tissue was greater in menstruation than in the pro-œstrum, and the monthly phenomena in the human female showed, at first sight, little resemblance to the sexual season of the sheep or bitch. The identification of menstruation with a part and not with the whole of the œstrous cycle helped to bring out the homology of the two processes, and the following schematic representation may be usefully kept in mind:—



Histological Changes.		Periods of the Œstrous Cycle.	
Period of growth .	}	Pro-œstrum	} Period of "Heat"
Period of destruction .		(Menstruation)	
Period of recuperation	{	Œstrus	} Not in "Heat"
Period of rest . . .		Metœstrum	
		Anœstrum	

Menstruation corresponded simply with the period of pro-œstrum in the lower mammals; it differed from it, in detail, by reason of the greater destruction of uterine tissue which took place in it, but the difference was insufficient to obscure the homology. Menstruation, therefore, did not correspond with the period of "heat" in the lower mammals, but only with the early part of that period, known as "coming into heat" or "season." If there was a definite period of desire in the human female, it would be the time immediately following menstruation, the period of "œstrus" (commencing recuperation of tissue) in the lower mammals.

Questions next arose as to the light these discoveries and identifications might throw upon the vexed question of the relation of ovulation to menstruation. There was evidence that in the rabbit, the ferret, and sometimes in the sheep, ovulation did not take place without the stimulus of coitus, and not, therefore, till the period of œstrus; in the bitch, also, ovulation occurred either during œstrus or in the later stage of the pro-œstrum. It was evident, therefore, that in these mammals the destruction-period of the pro-œstrum could not be regarded as the undoing of a preparation for a fertilised ovum (the preceding growth-stage), for the pro-œstrum was over or nearly over before ovulation (and fertilisation) occurred. Neither could menstruation, the homologue of the pro-œstrum, be so regarded, and therefore Sigismund's view (which looked upon the period of growth as a preparation for a fertilised ovum, and the period of destruction as the undoing thereof) could no longer be maintained. Further, the destruction-period of the pro-œstrum (and therefore also of menstruation) could not be regarded as of the nature of an abortion (as Beard had suggested in 1897), for in the case of the bitch, at any rate, it occurred before ovulation, and it could hardly be associated with the ovulation which had taken place at the preceding period of "heat" or œstrus six months before. Recent researches in the comparative physiology of the sexual season went to support the theory that menstruation in the human female and the periods of pro-œstrum and œstrus in other mammals were of the nature of preparation for an embryo—a sort of "surgical freshening" of the uterine mucosa for the reception and attachment of an impregnated ovum; there was also some evidence that the ovum was that discharged at the ovulation period immediately following the pro-œstrum (menstruation). It was probable that in the human subject the whole sexual season had lost its original characters, and had been changed, by evolution, into what it now was; there had, no doubt, once been a chronological arrangement of events similar to that now obtaining in the lower mammals; in other words, the usual period for ovulation in women had occurred after pro-œstrum (menstruation) during a period of œstrus. Even now there was some evidence to show that the most likely time for fertilisation to take place was during the week following menstruation.

We must turn next to the light which recent researches have thrown upon the influence of the ovaries upon menstruation. On the whole,



these investigations went to support the view that the changes in the uterus were dependent on those in the ovaries, for both in the human subject and in the lower mammals the removal of the latter organs caused the cessation of menstruation (in woman) and of the pro-œstrum and œstrus (in other mammals). The small number of exceptional cases were probably to be explained by failure to remove the whole of the ovarian tissue (see Bondi, *Wien. klin. Wochensch.*, xvii. p. 104, 1904; French, *Journ. Comp. Med. and Vet. Arch.*, xxii. p. 284, 1901; Taylor, *Vet. Journ.*, N. S., viii. p. 282, 1903; F. D. Thompson, *Texas Med. Gaz.*, iii., No. 12, 1903; and Wackerhagen, *Brooklyn Med. Journ.*, xvi. p. 424, 1902). At any rate, instances of pregnancy occurring after double ovariectomy or oophorectomy, such as the case reported by Doran (*Journ. Obstet. and Gynec. Brit. Emp.*, ii. p. 1, 1902), could hardly be accounted for in any other way; and if pregnancy might occasionally follow, why should not menstruation sometimes persist? There have been several theories as to the nature and mode of transmission of the ovarian influence. It could hardly be of a nervous character, cerebral or spinal, for experimental section of the spinal cord in animals did not prevent them coming into "heat"; ovarian grafting, also, was effectual in causing a reappearance of heat, although, of course, all the nervous connections of the transplanted glands had been severed (see Halban, J., *Monatssch. f. Geburtsh. u. Gynäk.*, xii. p. 496, 1900; Marshall and Jolly, *Proc. Physiol. Soc. Lond.*, p. xxvi., 1906). The weight of evidence was in favour of the view that the influence was chemical, and most probably of the nature of an internal secretion (a hormone or "activator"). The statement of L. Fraenkel's theory in 1903 (*Arch. f. Gynaek.*, lxviii. pp. 438-545, 1903) did much to focus attention upon the corpus luteum as the centre of ovarian activity. Born had already suggested that the corpus luteum of pregnancy was a gland with an internal secretion, which had to do with the embedding and development of the impregnated ovum in the uterus, but he was unable to carry out the experimental investigation necessary to establish his views, and this was done for him by Fraenkel. The results were striking, and carried Fraenkel further than Born had foreseen. He soon came to the conclusion that the corpus luteum was a gland; the character of the lutein cells and their mode of arrangement; its size, which was out of proportion to that of the unruptured Graafian follicle; and the signs of functional activity in the corpus luteum when all the rest of the ovary was quiescent and anæmic; these all pointed to its glandular character. Experiments showed that destruction or removal of corpora lutea brought an existing pregnancy to an end, or in the non-pregnant state prevented the onset of the next menstrual period. Andrews, in his summary (*Journ. Obstet. and Gynec. Brit. Emp.*, v. p. 459, 1904), says that Fraenkel's deductions were as follow:—The corpus luteum was a gland which was renewed every four weeks in women during reproductive life, and at varying intervals in animals. It controlled the nutrition of the uterus in a cyclic fashion, prevented it from relapsing into its infantile or passing into its senile condition, and prepared the endometrium for the reception of the ovum (or rather, in the light of Peters's work on ovum implantation, stimulated the activity of the trophoblast, and so fixed the ovum to the uterine wall). If the ovum were not fertilised, the corpus luteum produced the hyperæmia of menstruation and then degenerated. Menstruation was caused by the secretory activity of the corpus luteum, and not by the pressure of the



growing follicle on the ovarian nerves; and this activity produced the four-weekly hyperæmia which led on either to pregnancy or to menstruation. Anomalous uterine bleeding and some cases of sterility might depend on pathological conditions of the corpus luteum. Amenorrhœa and uterine atrophy might result from the same cause. Lactation-atrophy was a good example, for ovulation ceased, as a rule, during lactation, and therefore no fresh corpora lutea were formed. Fraenkel believed lutein to be the active principle, and recommended its use in troubles occurring at the menopause, and when ovariectomy had to be performed during pregnancy.

Whilst it may be said that in the main Fraenkel's theory of the importance of the corpus luteum in menstruation holds the field, it must be admitted that later researches have tended to undermine parts of it. The somewhat inert character of lutein, as determined by the physiological chemists, does not strengthen the view that it has such far-reaching effects upon the female economy. Again, the researches of J. Jankowski (*Arch. f. mikr. Anat.*, lxiv., p. 361, 1904) on the cells of the corpus luteum, showing that they arise from the tissue of the theca interna, and are therefore mesodermic in origin, weaken the claim that has been made for them that they perform secretory functions in connection with ovarian activity. In appearance they resemble epithelial cells, but appearances are deceitful in such matters, as may be shown by the puerperal changes of the stroma cells of the uterine mucous membrane. Further, the destruction or excision of a corpus luteum does not invariably prevent the occurrence of menstruation at the following period (Ries, *Amer. Journ. Obstet.*, xlix. p. 165, 1904; Kleinhaus and Schenk, *Zeitsch. f. Geburtsh. u. Gynäk.*, lxi. p. 283, 1907), as Fraenkel expected it would do.

If, however, it cannot be stated that Fraenkel's views regarding the importance of the corpus luteum and of lutein have been fully upheld by recent research, nevertheless the evidence in support of the dominant influence of the ovary is still very strong. It has been strengthened, for instance, by the results of transplantation experiments in animals and in the human subject: ovaries have been removed from one situation to another in the same animal (homoplastic transplantation), and they have been taken from one animal to another of the same species (heteroplastic transplantation); and in a few cases, both homotransplantation and heterotransplantation have been performed on the human subject. In all these varieties of grafting it has been claimed that conception has followed; even in heterotransplantation in the human female, Morris (*Med. Rec.*, lxi. p. 697, 1906) has reported a pregnancy and the birth of a living child. But, apart from this latter somewhat extraordinary result (in which the success can hardly be regarded as other than embarrassing), the grafting of ovaries has apparently counteracted the symptoms of the menopause and prevented the atrophy of the genitals which usually follows castration. There is a considerable literature on this subject of ovarian grafting (summaries of which, for English readers, are provided by the articles of Scott Carmichael, *Journ. Obstet. and Gynec. Brit. Emp.*, xi. p. 215, 1907, and of Franklin H. Martin, *Trans. Amer. Gynec. Soc.*, xxxiii. p. 489, 1908), and the general result of a perusal of what has been written is to support the view that the ovary will live and functionate in other localities than the normal one, and will prevent the troublesome sequelæ which usually occur at a premature menopause; but whether it does



so on account of persistence of ovulation or by reason of continued production of its internal secretion (apart from ovulation) is not clear.

The introduction into practice of the operation of hysterectomy and its performance in a large group of cases has raised the cognate question of the influence of the uterus upon the general metabolism of the body and upon the ovaries. Now the experiments of C. J. Bond and Sir Victor Horsley upon the two-horned uterus of rabbits (*Brit. Med. Journ.*, ii. for 1906, p. 121) seem to show that removal of the whole organ does not prevent the continuance of the functions of the ovary (ovulation going on as usual), and the taking away of one horn does not interfere with ovulation in the ovary of the same side. In the rabbit it was also found that there was a saline secretion taking place into the interior of the uterus, and it was thought that this antagonised in some way the ovarian internal secretion, that it prevented lutein formation in the ovary in pregnancy, and had a prejudicial effect on the general nutrition of the individual. Bond's experiments seemed, further, to prove that in the rabbit compensatory hypertrophy of one ovary takes place after removal of the other, and does so independently of the presence of the uterus so long as coition be continued. It cannot, however, be said that Bond's experiments or those of Carmichael and Marshall (*Proc. Roy. Soc.*, B. lxxix. p. 387, 1907) have done much to weaken the dominant rôle of the ovaries in menstruation; but the work done by Blair Bell and Pantland Hick (*Brit. Med. Journ.*, i. for 1909, pp. 517, 592, 655, and 716), while it does not show that removal of the uterus (in rabbits) produces marked changes in the ovaries, is none the less damaging to the theory of the importance of the ovaries. Blair Bell and Pantland Hick have been led by their investigations to the belief that the calcium content of the blood plays a leading part in the occurrence of menstruation, that the periodicity of the latter is due to the periodicity of the calcium metabolism, that rupture of Graafian follicles is in no way responsible for menstruation, and that, indeed, the ovary is no more predominant in respect to the menstrual function than the other ductless glands (*e.g.* the thyroid gland and pituitary body). These authors go so far as to say "that menstruation *per se* is not a necessary adjuvant, nor concomitant to fertility and reproduction"; they, therefore, arrive at results widely different from those of Fraenkel and his followers. The results, then, of the work on menstruation carried out during the first eight or nine years of the twentieth century cannot be said to contain the solution of the vexed question of the ovarian influence; but they indicate the lines of advance by which that matter may in time be settled. Meanwhile it would seem to be a matter of some practical importance for the patient who has her uterus removed to be spared one or both of her ovaries, so long at least as she is not beyond the menopause.

What have been called the *forensic aspects of menstruation* have been exercising the minds of some recent writers, and the matter is one which may be expected to assume greater importance if the franchise be given to women, and if women be elected to posts of responsibility involving nervous strain. It is well known that menstruation bears a relationship (of cause or only of effect is not yet certain) to insanity, and the frequency of the association of menstrual irregularities (precocious menarché, retarded puberty, amenorrhœa, etc.) with mental disorders has often been pointed out (recently, for instance, by Salerni, *Policlin.*, xiii., sez. med., p. 221, 1906, and by Sheila M. Ross, *Journ.*



*Ment. Sci.*, lv. p. 270, April 1909); it is also admitted that hysteria, epilepsy, and other nervous maladies are aggravated during the menstrual period; but it is not so generally accepted that in women otherwise normal the occurrence of menstruation may be the sole, or at least the only obvious cause of abnormal acts. Marx (*Berl. klin. Wochensch.*, xlv. p. 1776, 1908) has thrown some light upon this last-named question. He has pointed out that shop-thefts are nearly always perpetrated by women, a fact which is generally known, but he has further stated that the thief is nearly always found to be menstruating at the time when she is caught stealing. This fact, he adds, is specially noticeable in those apparently purposeless thefts, when the criminal is a woman in comfortable circumstances and even wealthy. Marx further is of opinion that menstruation may affect the reliability of the evidence of female witnesses in law cases, by altering their capability of observation and their soundness of judgment, although he admits that Wollenburg had found little difference in this respect between women in the intra-menstrual and in the extra-menstrual period. It is also pointed out that female suicides in most cases take away their lives during menstruation. Marx therefore comes to the conclusion that even women apparently healthy may pass into a condition of "transitory mental inferiority during the time of ovulation." But to settle this and other cognate questions is hardly possible on the evidence that has been collected; what is needed is a work containing full statistics of large numbers of cases in which the relationship of menstruation to the physical and mental health of the woman has been carefully ascertained and recorded, an expansion, in fact, of Mary Putnam Jacobi's Essay on *The Question of Rest for Women during Menstruation* which was published more than thirty years ago. Tobler's contribution (*Monatssch. f. Geburtsh. u. Gynäk.*, xxii. p. 1, 1905) to the subject, although small, is important; she finds that in most women at the present day menstruation is associated with distinct deterioration of the general health and diminution of functional energy, but in a small number of cases (3·3 per cent.) there is greater strength in the mental and other functions during the period.

## Menstruation, Morbid.

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1. AMENORRHŒA.—In addition to the causes of amenorrhœa usually enumerated (vide *Encyclopædia Medica*, Vol. VIII. p. 9), it may be found necessary to mention eye diseases, such as hæmorrhages into the vitreous. J. E. Gemmell (*Journ. Obstet. and Gynec. Brit. Emp.*, v. p. 445, 1904) has, at any rate, recorded a case in which a girl of 16 years of age ceased to menstruate, and at the same time lost the sight of the right eye, and developed a faint floating vitreous cloud in the left. There was no anæmia, and the blood and urine were found to be normal. The only other possible causes of the amenorrhœa were that the girl had left home for the first time to go to school, and had been subject to some mental strain in connection with her lessons. Under the administration of iron and aloes and thyroid tabloids, along with local treatment of the eyes, menstruation returned, and the sight of the left eye was fully recovered, but very little improvement took place in the right. The



author was of opinion that the hæmorrhages into the vitreous might be regarded as due to vicarious menstruation. Blondel and Sendral (*Gynécologie*, ix. p. 5, 1904) have also reported a case in which amenorrhœa was associated with eye disease. The patient, at the age of 29, lost her husband, and began to suffer from irregular menstruation, followed in a year by amenorrhœa. At the same time the sight of the left eye began to depreciate, and, notwithstanding sympathectomy and iridectomy, was lost by the age of 32 years; an ulcer developed on the cornea of the right eye. Under emmenagogue treatment (ovarine capsules, apiol tabloids, and iron and aloes), menstruation was restored, and the sight of the right eye recovered, through healing of the corneal ulcer; the useless left eyeball was removed. These two cases strengthen the belief, that has often been expressed, in the possibility of vicarious menstruation (*xenomenia*), although they cannot be regarded as affording absolute proof; they, at any rate, indicate close sympathy between menstrual phenomena in the uterus and the functions of other bodily organs. Other alleged instances of vicarious menstruation have been reported by Delaney (*Virginia Med. Semi-Month.*, ix. p. 536, 1904-5), Gillmore (*Amer. Journ. Obstet.*, liii. p. 520, 1906), Scherer (*Beitr. z. klin. d. Tuberk.*, vi. p. 287, 1906), Shambaugh (*Laryngoscope*, xvi. p. 53, 1906), and Larrabee (*Boston Med. and Surg. Journ.*, clvii. p. 217, 1907).

Recent researches have shown that the so-called physiological amenorrhœa of lactation is by no means so constant as has been supposed. Thus, Elis Essen-Möller (*Zentralb. f. Gynäk.*, xxx. p. 175, 1906) has found that in 59·3 per cent. of 428 nursing women, menstruation went on normally; no discharge occurred in 32·3 per cent.; whilst 8·5 per cent. showed irregularities. Karl Heil (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiii. p. 340, 1906) studied the histories of 200 women, with, in all, 540 deliveries, and found that 125 of these women experienced the return of menstruation while they were suckling their babies. In 234 of 499 lactations the periods were re-established before weaning, the time distribution being as follows:—first six weeks, 37; second six weeks, 62; three to twelve months, 100; later, 4; and 31 were indefinite. Heil's general conclusion was, about half only of all women who are nursing their infants have absolute amenorrhœa; he thought that the appearance of the menses during lactation was not a reason for weaning; and he was of opinion that menstruation, and not amenorrhœa, was the original normal condition with women during lactation. These observations must be taken into account in connection with the common practice of weaning on the appearance of menstruation. Apparently ablactation is not so necessary in that case as has been supposed; and probably the supervention of another pregnancy is a far more pressing indication for weaning, as Church has pointed out in an article on the risks of allowing lactation and pregnancy to overlap (*Trans. Edin. Obstet. Soc.*, xxviii. p. 204, 1903).

2. **DYSMENORRHŒA.**—It was towards the close of 1896 that Fliess (*Zentralb. f. Gynäk.*, xxi. p. 111, 1897) made a communication to the Berlin Obstetrical and Gynecological Society in which he claimed that there existed a close connection between the nasal mucous membrane and menstruation. The forms of dysmenorrhœa in which the pain continued after the appearance of the bleeding had in a great number of cases their origin in the nose. This was not to be wondered at, for during menstruation regular changes occurred in the nose, and these consisted of swelling, increased sensitiveness to touch, a tendency to bleed, and



cyanotic discoloration. These changes were most marked on the inferior turbinated bones and on the tubercula septi, and to these spots in particular the name of the "genital areas" of the nose might be given. Temporary relief of the pain of dysmenorrhœa was obtained by applying cocaine to these "genital spots," and in some cases the relief was made permanent by cauterising the same regions. Since the publication of Fliess's article the subject has been investigated by many observers, who have to a certain extent corroborated Fliess's statements, and found benefit to accrue from the nasal treatment recommended. It has been found to be difficult to eliminate entirely the possibility of cure by suggestion. A. Schiff (*Wien. klin. Wochensch.*, xiv. pp. 57-65, etc., 1901) found that cocainisation of the tubercula septi relieved the sacralgia, whilst the abdominal pain was also benefited when the "nasal spots" on the inferior turbinateds were similarly treated. A few drops of a 20 per cent. solution of cocaine were applied on cotton-wool. In a smaller number of cases permanent relief followed cauterisation. A. Ephraim (*Allg. med. Centr.-Ztg.*, lxxi. p. 229, 241, 1902) obtained good results in three-fourths of the patients whom he treated by cocainisation of the "genital spots." During the past six or seven years a considerable number of communications on this subject, and on the nearly allied one of the relationship between the nasal mucous membrane and the genital organs in the male, have appeared in current medical literature, and among these may be named papers by Hall (*Westminster Hosp. Rep.*, xii. p. 65, 1901), Heymann (*Verhandl. d. Gesellsch. f. Geburtsh. zu Leipz.*, p. 41, 1902), Jaworski and Iwanicki (*Gaz. lek.*, 2 S., xxii. pp. 429, 456, 1902), Krönig (*Verhandl. d. Gesellsch. f. Geburtsh. zu Leipz.*, pp. 41-48, 1902), Pitous (*Thèse* (Bordeaux), 1902), Haug (*Monatssch. f. Ohrenh.*, xxxvii. p. 96, 1903), Heiman (*Rev. hebdom. de laryngol.*, ii. p. 209, 1903), H. Löwy (*Verhandl. d. Gesellsch. deutsche Naturf. u. Aerzte*, 1902 (Leipz.), ii. pp. 2, 206, 1903), A. Malherbe (*Ann. d'electrobiol.*, vi. p. 561, 1903), F. La Torre (*Clin. ostet.* (Roma), v. p. 345, 1903), Trautmann (*Monatssch. f. Ohrenh.*, xxxvii. p. 129, 1903), Kolischer (*Amer. Journ. Obstet.*, xlix. p. 804, 1904), A. Martin (*Rev. frenopat. españ.*, ii. p. 133, 1904), Opitz (*Verhandl. d. deutsche Gesellsch. f. Gynäk.*, x. p. 683, 1904), Vacher (*Ann. méd.-chir. du Centre* (Tours), iv. p. 25, 1904), Delie (*Rev. hebdom. de laryngol.*, ii. p. 641, 1905), M. Falta (*Monatssch. f. Ohrenh.*, xxxix. p. 506, 1905), B. Reko (*Allg. Wien. med. Ztg.*, i. pp. 270, 280, 1905), L. Chierici (*Riv. veneta di sc. med.*, xlv. p. 416, 1906), Latis (*Arch. ital. di ginec.*, i. p. 263, 1906), C. Jacobs (*Progrès méd. belge*, viii. p. 145, 1906), Royet (*Arch. internat. de laryngol.*, xxiii. p. 715, 1907), Kuttner (*Deutsche med. Wochensch.*, xxxiv. p. 1050, 1908), and F. E. Walker (*Journ. Amer. Med. Assoc.*, li. p. 1077, 1908). Although the question cannot yet be regarded as definitely settled, it may be said that there is a considerable body of evidence in support of the belief in the existence of what may be called nasal dysmenorrhœa, and a certain amount of proof that local nasal treatment (by the application of cocaine to the "genital spots" on the septum nasi and inferior turbinateds) is beneficial in a large proportion of these cases. Of course it is well known that certain odours and perfumes stimulate the genital sense (see A. Hagen, *Die sexuelle Oosphresiologie* (Charlottenburg), 1901, and others), and cases of priapism as a nasal reflex are not unknown (Hobbs, *Gaillard's South. Med.*, lxxxiv. p. 187, 1906); and these facts increase the likelihood of the existence of nasal dysmenorrhœa. Further, it has been shown by H. W. Freund (*Monatssch. f. Geburtsh. u. Gynäk.*, xx. pp. 210, 383, 1904) and others that nasal and



pharyngeal changes are associated with the processes of pregnancy, labour, and the puerperium, as well as with the phenomenon of menstruation. Freund found that 66 per cent. of pregnant women had hyperæmia of the pharyngeal mucous membrane and hypertrophy of the turbinated bones (especially the inferior ones), and that the nasal changes were not periodic but persisted throughout the gestation, causing epistaxis in 25 per cent. of the cases. They sometimes continued during the puerperium, and were not influenced by lactation. The swelling of the turbinated bones increased during the pains of labour. In certain patients swelling of the septum of the nose and of the turbinated bones seemed to cause hyperemesis gravidarum, for the vomiting ceased after the application of the galvano-cautery to the swollen parts. Hyperæmia of the pharynx and hypertrophy of the tonsils were less frequently met with in pregnancy than were the nasal changes.

A *statistical investigation* of primary and secondary *dysmenorrhœa* in girls has been made by Marie Tobler (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvi. p. 801, 1907). Seven hundred cases were reviewed; in 234 of these the symptom was primary (*i.e.* began at the menarché), and in 466 it was secondary. She found that the dysmenorrhœa of young girls was markedly premenstrual, and had its climax during the first hours of the show of blood; it was very often secondary, a fact which was not in favour of its mechanical origin (uterine displacements and stenoses); neither was there evidence to show that its origin lay in the nervous system. The conclusion drawn was that disturbances of the pelvic circulation constituted the common causes. Herman and Andrews (*Journ. Obstet. and Gynec. Brit. Emp.*, iii. pp. 1, 83, 1903), on the other hand, from a review of cases at the London Hospital, have ascribed the pain to uterine contractions, and have seen marked benefit following cervical dilatation. Routh (*Brit. Med. Journ.*, ii. for 1906, p. 234) gives an able summary of the modern aspects of dysmenorrhœa, both as regards causation and treatment.

Among the new methods of treatment which have been introduced for the alleviation of metrorrhagia and dysmenorrhœa is *radiotherapy*. Fraenkel (*Zentralb. f. Gynäk.*, xxxii. p. 142, 1908) employed the Röntgen rays in such cases with good effect; but he warns others who may use this agent to make the applications in such a way as to avoid the sterilising effect of the rays upon the ovaries. The effect of *styptol* in cases of idiopathic dysmenorrhœa is highly spoken of by Jacoby (*Therap. d. Gegenw.*, xlvii. p. 253, 1906); the improvement which follows is ascribed to the double sedative and hæmostatic properties of the drug. For stubborn cases of dysmenorrhœa, Polano (*Münch. med. Wochensch.*, liv. p. 1731, 1907) recommends the application of *Klapp's suction apparatus* to each breast for a quarter to half an hour at a time for some days before the onset of the menstrual flow.

3. INTERMENSTRUAL PAIN (*Mittelschmerz*).—Closely associated with dysmenorrhœa is mid-pain (*Mittelschmerz*), a little-understood phenomenon, apt to recur, and difficult to cure. It has recently been discussed at a meeting of the Royal Academy of Medicine in Ireland (*Brit. Med. Journ.*, i. for 1909, p. 91), in connection with contributions by Purefoy and Shiell, when it was suggested that it was due to some form of toxæmia arising from an excess of internal secretion of the ovary. Purefoy did not regard it as due to hydrosalpinx. Rosner (*Gynécologie*, x. p. 230, 1905) agreed with Richelot in ascribing intermenstrual pain to diffuse hyperæmia and hypertrophy of the uterus of



a non-inflammatory nature; he did not regard it as set up by contractions of the Fallopian tubes. He thought that varicosity of the pelvic veins was a causal factor, and recommended systematic firm packing of the vagina (to support the veins) as a means of treatment. It must be confessed that no thoroughly satisfactory mode of treatment has been discovered; curettage, dilatation, and drugs have all failed, and hysterectomy and oophorectomy are hardly justifiable. Associated, perhaps, with Mittelschmerz is *intermenstrual fever*, of which Van Voornweld (*Zeitsch. f. Tuberk. u. Heilstättenw.*, vii. p. 543, 1905) has recorded an instance in a girl of 18 suffering from phthisis; the observer did not regard the phenomenon as due to tubercular salpingitis, but that morbid state could not be absolutely excluded; he was inclined to look upon the fever as a token of a periodical intermenstrual hyperæsthesia of the heat centre. H. Kraus (*Wien. med. Wochens.*, lv. p. 610, 1905) has found premenstrual fever in two-thirds of the tubercular patients under his care; in some of these cases the rise in temperature was intermenstrual; it bore no relation to the gravity of the general tubercular infection. It must be admitted that the Mittelschmerz is still a mystery.

4. MENSTRUATIO PRÆCOX.—A certain degree of mystery surrounds also early menstruation (*menstruatio præcox*). According to Wischmann (*Norsk. Mag. f. Lægevidensk.*, 5 R. i. p. 306, 1903) there are two groups, that in which the phenomenon is associated with rickets or hydrocephalus and that in which it is accompanied by other signs of puberty (enlargement of mammæ, appearance of hair on the mons and elsewhere). Wischmann himself records a case of the latter type, in which menstruation began at the age of 18 months; there were twelve periods. In Näcke's patient (*Zentralb. f. Gynäk.*, xxxii. p. 1116, 1908) there were signs of rickets during the first two years of life, and at the age of 3 menstruation began, and soon afterwards other signs of puberty began to appear. At the age of 5 years the child had the build of 8 years, and the vagina and left ovary had the development of a child of 11. Her mother had been pregnant eleven times, and Näcke remarked that unusual fertility of the parent of a child with early menstruation had been observed in connection with other cases. Stoeltzner (*Med. Klin.*, iv. p. 5, 1908) has recorded another instance of *menstruatio præcox*, and Hendrix (*Policlin.* (Bruxelles), xv. p. 1, 1906) noted a case in which periodic discharges began at the age of 8 months and had continued till the third year.

5. MENORRHAGIA AND METRORRHAGIA.—It is admitted by everyone that menorrhagia and metrorrhagia are symptoms due to many different diseases; but there is still considerable difficulty in discovering the causal disease in every case, and specially in some forms of bleeding at the menopause. There is a tendency to ascribe to hæmophilia these cases of climacteric hæmorrhage in which there is neither a tumour (*e.g.* cancer of the cervix or body or fibroid tumour) nor a diseased state of the uterine mucous membrane (*e.g.* fungous endometritis); but Dickinson (*Brooklyn Med. Journ.*, xx. p. 45, 1906) is not of this opinion, and believes that in such cases the cause is arterio-sclerosis (of the uterine vessels), obstruction to the return circulation, diseased structure and function of the ovary, or increase in the connective tissue in the uterine wall. The arterio-sclerosis may affect the uterus alone, and not the general vascular system, although a clear case has not yet been described. Palmer Findley (*Trans. Amer. Gynec. Soc.*, xxx. p. 399, 1905) has written at length on the subject of arterio-sclerosis of the



uterus, and Elizabeth H. B. Macdonald (*Trans. Edin. Obstet. Soc.*, xxxii. p. 83, 1907) has made a valuable addition to our knowledge of its morbid anatomy (with a bibliography); but there is still some obscurity surrounding the causation of metrorrhagia myopathica and chronic metritis. (See also Barbour, *Trans. Edin. Obstet. Soc.*, xxx. p. 71, 1905; Anspach, *Amer. Journ. Obstet.*, liii. p. 1, 1906; and Solowij, *Monatssch. f. Geburtsh. u. Gynäk.*, xxv. p. 291, 1907.)

Midwives.

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DERIVATION AND DEFINITION.—The etymology of the word *midwife* is not clearly ascertained. Probably *mid* has the meaning of the preposition *with*, and the word therefore signifies anyone (male or female) who is with the woman (*wyf*) at the time of her confinement; if this be so, then the word has its analogies in the German *bei-frau* and the Spanish *co-madre*. But it is possible that *mid* has an adjectival meaning and that *midwife*, therefore, indicates “a woman by whose means the delivery is effected.” But even if the word originally did not necessarily imply that the midwife was a woman, it soon came to be used only in the sense of a female accoucheur, a woman who assisted other women at their labours; for when men began occasionally to practise midwifery the name *man-midwife* was coined to express the office. The word “accoucheuse” is comparatively modern. From *midwife*, of course, comes *midwifery*, the art of helping women in their labours, or obstetrics. The latter term is derived from the Latin *obstetrix*, a midwife, which literally means one who stands in front of or over against (*ob, stare*), and refers to the former practice of the assistant standing or sitting in front of the parturient patient and receiving the infant as it was born. *Obstetrics* is now the name often given to the art and science of midwifery, and *obstetrician* is the noun; sometimes “female obstetrician” is used as equivalent to midwife or accoucheuse.

HISTORICAL SKETCH.—No doubt women assisted women at their confinements from the earliest periods of the world’s history, and men—priests, priest-physicians, or surgeons—were called in to assist only in cases of dire necessity and pressing danger. The midwives were doubtless women who had themselves given birth to several children, who had attended many of their relatives in childbed, or who had gathered some rudimentary notions of the art from acting as assistants to other more experienced midwives. They had no knowledge of the anatomy of the female generative organs, and their practice, therefore, was one of “rule of thumb,” quite empiric. Nevertheless, the midwives were a recognised part of the economy of a nation (as we learn from Exodus i. 15-20), and, no doubt, some of them attained to some degree of skill in their art, although they had no organised teaching and no text-books.



We may form some idea of the low level to which the practice of midwifery had sunk in Europe in the sixteenth century from the perusal of Rhodion's *De Partu Hominis*, a work translated into English in 1540 by Jonas and revised later by Raynalde. This work, which was termed the *Byrth of Mankynde*, professes to meet a crying want and to give midwives a means of learning better how to treat the women in labour who constituted their patients. But if the *Byrth of Mankynde* was an advance upon earlier obstetric practice, we can only lament the ignorance of previous midwives and the gross mismanagement that cases of even normal labour must have suffered from; for, assuredly, this book, even as it is "newly set forth, corrected, and augmented" by Raynalde, is full of amazing blunders and of meddlesome and dangerous practices and manipulations.<sup>1</sup> It was more than time that the midwives should receive some training in their art. But there was no one capable of giving such teaching; for men were not allowed by public opinion to act as attendants upon women in normal labours, and the experience they gained at the difficult cases was purely surgical, resolving itself into the practice of dismemberment of the foetal body. About the middle of the sixteenth century, however, a change began to take place. Paré introduced podalic version into obstetric practice in 1550, and Louyse Bourgeois (1563-1636), the famous midwife of the French royal family, was one of the first graduates of a school for midwives established in the Hôtel Dieu in Paris. Louyse Bourgeois also published a work on midwifery which helped to raise the standard of the practice of the obstetric art in France. In the seventeenth and eighteenth centuries, however, various occurrences contributed to the introduction of men into the practice of midwifery. The forceps was invented by the Chamberlens, reinvented by Palfyn, and perfected by Levret (1745); scientific treatises on midwifery by physicians (Mauriceau and others) began to appear; and fashion, one of the most powerful influences in social habits and custom, prescribed that women should be attended at their confinements by male physicians or surgeons. It is true that more thorough provision for the teaching of midwives was made and that some distinguished midwives (among whom may be named Justine Siegemundin of Brandenburg, Madame Boivin in France, and Mrs. Jane Sharp and Mrs. Nihell in England) practised the art of obstetrics; but slowly and surely midwifery was passing into the hands of men. The midwives, however, did not easily let the practice slip away from them; and for many years, in England at least, a fierce struggle was carried on, Mrs. Nihell on the one side and Dr. Smellie on the other waging a wordy war. There is reason to believe that some of the persons attending the lectures on midwifery given by the professor of the subject in the University of Edinburgh were midwives; and in Scotland the practice of obstetrics seems to have been longer left to women than in England. This university professorship, apparently the first, was instituted in 1726, when Mr. Joseph Gibson was appointed to the post; but although this was so, even towards the close of the eighteenth century "the profession of an accoucheur was esteemed very unbecoming for a gentleman." The arrival of the nineteenth century saw the practice of midwifery pass almost entirely into the hands of regular medical practitioners, the midwives as a rule retaining only attendance

<sup>1</sup> The reader will find an account of sixteenth-century midwifery as practised in England in the *Journal of Obstetrics and Gynæcology of the British Empire* for October 1906 and September and October 1907.



upon women of the poorer classes or those living in out-of-the-way districts. The admission of women to the medical profession towards the close of the century began to restore some of the work among the better classes to female hands; but, simultaneously therewith, came the Midwives Registration Act for the better training of midwives and for the regulating of their practice, which has had so profound an influence upon this whole question. This leads me to refer to the legislation on the subject.

LEGISLATION FOR MIDWIVES.—The earliest legislation regarding midwives in England seems to have had reference to their ecclesiastical rather than their obstetric duties, for in cases of emergency and in the absence of the priest the midwife might be required to baptise the newborn infant. There is an ancient injunction to the clergy by the Archbishop of York, which reads: "All curates must openly in the church teach and instruct the mydwiefes of the very words and form of baptisme to thentents that they may use them perfectly well and none oder." It is in this connection that the practice of the licensing of midwives by bishops apparently had its origin. Here, at any rate, is the oath administered by the Archbishop of Canterbury to Eleoner Pead in 1567 when he licensed her as a midwife: "I, Eleoner Pead, admitted to the office and occupation of a midwife, will faithfully and diligently exercise the said office according to such cunning and knowledge as God hath given me, and that I will be ready to help and aid as well poor as rich women being in labour and travail of child, and will always be ready both to poor and rich in exercising and executing of my said office. Also I will not permit or suffer that any woman being in labour or travail shall name any other to be the father of her child, than only he who is the right and true father thereof; and that I will not suffer any other body's child to be set, brought, or laid before any woman delivered of child in the place of her natural child, so far forth as I can know or understand. Also I will not use any kind of sorcery or incantation in the time of the travail of any woman; and that I will not destroy the child born of any woman, nor cut, nor pull off the head thereof, or otherwise dismember or hurt the same, or suffer it to be hurt or dismembered by any manner of way or means. Also that at the ministration of the sacrament of baptism in the time of necessity, I will use apt and accustomed words of the same sacrament—that is to say, these words following, or the like in effect: *I christen thee in the name of the Father, the Son, and the Holy Ghost*, and none other profane words. And that in such time of necessity, in baptising any infant born, and pouring water upon the head of the said infant, I will use pure and clear water, and not any rose or damask water, or water made of any confection or mixture; and that I will certify the curate of the parish church of every such baptising."

At the Hampton Court Conference (1604), however, it was decided to limit the performance of baptism to persons in orders, and after this date the midwives' oath was no doubt remodelled. The next legislation was to deal with their obstetric qualifications, but it was to be long delayed. It is interesting to find that near the close of the sixteenth century there was an agitation for the supervision by the bishops of the medical training of midwives. In Boorde's *Brevyary of Health* (quoted by Aveling, in his *English Midwives*, p. 14) there is the suggestion that "the Byshoppe, with the consent of a doctor of physick, ought to examine her (the midwife), and to instruct her in that thyng that



she is ignorant; . . . for and this were used in Englonde there shulde not halfe so many women myscary, nor so many chyldren perish in every place in Englonde as there be. The Byshop ought to loke on this matter." In the early part of the seventeenth century Dr. Peter Chamberlen proposed "that some order may be settled by the State for the instruction and civil government of midwives," and, the State having failed to respond, Chamberlen's son tried himself to get the project carried out some thirty years later (1646); but these obstetricians were far in advance of their age, and their attempts were futile. During the eighteenth century there was no legislation for midwives, but better books for their instruction began to appear; and the example of the immortal Harvey in interesting himself in the problems of parturition began to be followed by other scientific men with the result, as we have seen, that better-class obstetric practice began to pass into the hands of the medical profession. But the need for some plan of training and certifying midwives was none the less clamant. The notorious Mrs. Cellier (of "Meal-tub Plot" fame) had a wonderful scheme (1687) for the establishment of a "corporation of skilful midwives," and a royal hospital with a principal physician or man-midwife "to examine all extraordinary accidents, and once a month at least read a publick lecture to the whole society of licensed midwives, who are all obliged to be present at it, if not employed in their practice"; but it was quite impracticable. Dr. Mawbray (1725) did much to improve the training and status of the midwife, and James Douglas (1736) proposed, in a more practical fashion than Mrs. Cellier had done, that an hospital be erected "for the reception of two or three hundred women who are big with child, that a proper number of midwomen be appointed to attend them," and that these midwomen should be obliged to attend courses of instruction, should be afterwards examined, and receive a certificate if found to deserve it, etc. Similar propositions were made by Manningham (1739), Counsell (1752), Blunt (1793) and others (1795); but the State took no action. The result was that as the Church had ceased to license midwives, and as the medical faculty had not taken upon itself the duty of doing so, a large class of midwives were found in practice some of whom it is true had received training but many had not, and there was no way of distinguishing the trained from the untrained.

At the beginning of the nineteenth century the need for legislation was urgent, but it was not given effect to till the beginning of the twentieth century. In 1803 regulations for the training and control of midwives were adopted in France, in 1810 in Austria and in Sweden and Norway, in Belgium in 1818, and in Holland in 1865. It is true that in 1813 an attempt was made to get the British Parliament to pass enactments "for the examination and control of midwives, making it penal for any woman to practise without a license, granted after examination"; but no legislative result followed. In due time Medical Acts were passed, but the portion relating to midwives was dropped out of them. During the last decade of the century, however, it became plain that legislation could not be much longer delayed. Select committees of the House of Commons met and reported in 1892 and 1893, and the General Medical Council in 1889 and 1893 was strongly in favour of the passing of laws regulating the education and supervision of midwives. Legislative efforts were made to obtain the registration of midwives in 1898 and 1899, but it was not till 1902,



one hundred years after France had led the way, that England got its Midwives Registration Bill. It came into operation on 1st April 1903.

While these attempts toward legislation had been going on, the education of midwives had been carried on by the staffs of the various maternity hospitals, some of which gave certificates of which some were based upon examinations; but it was quite possible for ignorant women to commence practising without giving or being required to give to the public any such assurance of capability or skill. In 1872 the Obstetrical Society of London began to make arrangements for the examining of women desiring to become midwives; in that year eight women applied, of whom six passed and two failed to obtain the L.O.S. "diploma." In 1873, twelve women applied and eleven passed. For the next five years the numbers applying were very small; but by the end of 1894 there were over four hundred women endeavouring annually to obtain this certificate of efficiency, and the total number on the register was 2166. The Society in its diploma certified that the bearer was a "skilled midwife competent to attend Natural Labours," and it required from each candidate a certificate of good moral character, one showing that she was not under twenty-one years of age, and proof of having personally attended not less than twenty-five labours under supervision satisfactory to the Board of Examiners. Each candidate had also to pass a written and oral and practical examination in certain subjects in obstetrics, including natural labour, the indications of abnormal labours, the hæmorrhages, antiseptics, and the management of the puerperal state. Exception was taken by the General Medical Council to the wording of the diploma as suggesting that the holder had a registrable qualification; but the Society did good pioneer work in the training of midwives until the passing of the Bill in 1902. The maternity hospitals in Scotland also gave certificates to their pupils after examination, and elsewhere laudable efforts were made to improve the training of monthly nurses; but till 1902 there was no control over the practice of inefficient or ignorant women. The Midwives Act was not made applicable to Scotland; but the Scottish maternity hospitals train pupils for passing the examinations required by it, and no doubt its effect has been to raise the standard of education all over the country. Let us now look at the Act itself.

THE MIDWIVES ACT (2 EDW. 7, CAP. 17).—The purpose of the Act was to secure the better training of midwives and to regulate their practice. It was enacted by it that "from and after the first day of April 1905, any woman who not being certified under this Act shall take or use the name or title of midwife (either alone or in combination with any other word or words), or any name, title, or description implying that she is certified under this Act, or is a person specially qualified to practise midwifery, or is recognised by law as a midwife, shall be liable on summary conviction to a fine not exceeding five pounds. From and after the first day of April 1910, no woman shall habitually and for gain attend women in childbirth otherwise than under the direction of a qualified medical practitioner unless she be certified under this Act; any woman so acting without being certified under this Act shall be liable on summary conviction to a fine not exceeding ten pounds, provided this section shall not apply to legally qualified medical practitioners, or to anyone rendering assistance in a case of emergency." Certification under the Act implies the fulfilment of various conditions to be specified below, and no uncertified person can be employed as a



substitute. Further, "the certificate under this Act shall not confer upon any woman any right or title to be registered under the Medical Acts or to assume any name, title, or designation implying that she is by law recognised as a medical practitioner, or that she is authorised to grant any medical certificate, or any certificate of death or of still-birth, or to undertake the charge of cases of abnormality or disease in connection with parturition." The Act also made provision by which an existing midwife might during 1903 and 1904 be certified if she held a certificate from various institutions and if she had been for at least one year in *bonâ fide* practice as a midwife, and bore a good character. The Act then proceeded to deal with the Constitution and duties of the Central Midwives Board (C.M.B.), with appeals from its decisions, with fees and expenses, with the Midwives' Roll, with the local supervision of midwives, with notification of practice, with penalties for obtaining certificates by false representation, etc. We shall now look at some of the rules and regulations which have emerged from this Act.

**THE CENTRAL MIDWIVES BOARD.**—The Midwives Act created a Central Midwives Board consisting of (1) four registered medical practitioners, of whom the Royal College of Physicians, the Royal College of Surgeons, the Society of Apothecaries, and the Incorporated Midwives' Institute each appoint one; (2) two persons appointed by the Lord President of the Council, of whom one is a woman; and (3) three persons of whom the Association of County Councils, Queen Victoria's Jubilee Institute of Nurses, and the Royal British Nurses' Association each appoint one. The individual members of the Board at present are named below:—

## MEMBERS.

Sir W. J. SINCLAIR, M.D.	.	.	.	Appointed by the	Lord President of the Council.
Miss JANE WILSON	.	.	.		Lord President of the Council.
F. H. CHAMPNEYS, M.D. (Chairman)	.	.	.		Royal College of Physicians.
J. WARD COUSINS, M.D., F.R.C.S.	.	.	.		Royal College of Surgeons.
E. PARKER YOUNG, M.R.C.S.	.	.	.		Society of Apothecaries.
STANLEY B. ATKINSON, M.B.	.	.	.		Incorporated Midwives' Institute.
H. G. FORDHAM, D.L., J.P.	.	.	.		Association of County Councils.
Miss ROSALIND PAGET	.	.	.		Queen Victoria's Jubilee Institute for Nurses.
Mrs. JOSEPHINE LATTER	.	.	.		Royal British Nurses' Association.
Secretary—G. W. DUNCAN, Esq., Caxton House, Westminster, S.W.					

The Board shall meet on the last Thursday in each month: the quorum shall be four; and at each monthly meeting a financial statement shall be made by the secretary. The duties and powers of the Board include the framing of rules for the training and examining of candidates for the certificate, the appointing of examiners, the fixing of the places where examinations are to be held and of the times when they are to be held, the publication of an annual Roll of Midwives, the removal of names from the Roll, and the issuing and cancelling of certificates. The Board shall also receive reports from the local supervising authorities ("Every council of a county or county borough throughout England and Wales shall, on the commencement of this Act, be the local supervising authority over midwives within the area of the said county or county borough") regarding the midwives practising in the areas supervised by these authorities.

**CONDITIONS OF CERTIFICATION.**—The conditions of admission to the



Roll of Midwives, as laid down by the C.M.B., are as follow:—The applicant must supply a certificate of birth or of baptism, or a statutory declaration made by a competent person, showing that she (the applicant) is not under twenty-one years of age, and, where the candidate has been married, the certificate of marriage as well. She must also send in a certificate of good moral character which must be worded according to the form supplied by the Board. She must show certificates to the effect that she has had the training prescribed by the Board, and the certificates must be as follow:—

FORM III.—*Certificate of Attendance on Cases.*

(See Section C 1 (1) above.)

I certify that.....(to whom this certificate refers) has, under my supervision, and to my satisfaction, attended and watched the progress of not fewer than twenty labours, making abdominal and vaginal examinations during the course of labour, and personally delivering the patient.

Dated this.....day of.....19.....

Name.....

Address.....

Position and authority for signing.....

Signature of applicant.....

FORM IV.—*Certificate of Attendance during the Lying-in Period.*

(See Section C 1 (2) above.)

I certify that.....(to whom this certificate refers) has, under my supervision, and to my satisfaction, nursed twenty lying-in women during the ten days following labour.

Dated this.....day of.....19.....

Name.....

Address.....

Position and authority for signing.....

Signature of applicant.....

FORM V.—*Certificate of having Attended a Course of Instruction.*

(See Section C 1 (3) above.)

I certify that.....(to whom this certificate refers) has attended, to my satisfaction, a course of instruction in the subjects enumerated in Rule C 4, extending over a period of not less than three months, and consisting of not less than fifteen lectures, and has shown that she possesses sufficient elementary education to enable her to read and to take notes of cases.

Dated this.....day of.....19.....

Name.....

Address.....

Professional Qualifications.....

Position and authority for signing.....

Signature of applicant.....

Forms III. and IV. may be signed “either by a registered medical practitioner or by the Chief Midwife, or, in the absence of such an officer, by the matron of an institution recognised by the Board, or, in



the case of a poor-law institution, by the matron, being a Midwife certified under the Midwives Act, or a superintendent nurse, certified in like manner, and appointed under the Nursing-in-Workhouses Order, 1897, and attached to such an institution, or by a Midwife certified under the Midwives Act and approved by the Board for the purpose." Form V. must be signed by a registered medical practitioner recognised by the Board as a teacher.

Having satisfied the Board regarding these matters, the candidate gives notice to the secretary of the C.M.B. of her intention to enter for the next examination at least three weeks before the date fixed for that examination, and pays the necessary fee (one guinea for the first appearance, and fifteen shillings if she have previously appeared and failed to pass). The examinations (the dates of the holding of which are publicly announced) are partly oral and practical and partly written, and a want of acquaintance with the ordinary subjects of elementary education may be sufficient ground for rejection. The following subjects are included in the examination: (*a*) The elementary anatomy of the female pelvis and generative organs; (*b*) pregnancy and its principal complications, including abortion; (*c*) the symptoms, mechanism, course and management of natural labour; (*d*) the signs that a labour is abnormal; (*e*) hæmorrhage: its varieties and the treatment of such; (*f*) antiseptics in midwifery and the way to prepare and use them; (*g*) the management of the puerperal patient, including the use of the clinical thermometer and of the catheter; (*h*) the management (including the feeding) of infants, and the signs of the diseases which may develop during the first ten days; (*i*) the duties of the midwife as described in the regulations; (*j*) obstetric emergencies and how the midwife should deal with them until the arrival of a doctor. This will include some knowledge of the drugs commonly needed in such cases, and of the mode of their administration (*vide Regulation of Practice of Midwives*); (*k*) puerperal fevers: their nature, causes, and symptoms; (*l*) the disinfection of person, clothing and appliances; (*m*) the principles of hygiene as regards the home, food-supply, and person; and (*n*) the care of children born apparently lifeless.

If the candidate successfully passes her examination, she shall have her name entered by the secretary on the Roll of Midwives (which is alphabetical, is printed in one single list, and is published annually), having received a certificate the wording of which is as follows (*vide* Form II.):—

FORM II.—*Central Midwives Board.*  
(2 Edw. 7, c. 17.)

No..... Date.....

We hereby certify that.....  
.....having passed the examination of the Central  
Midwives Board, and having otherwise complied with the rules and  
regulations laid down in pursuance of the Midwives Act, 1902, is entitled  
by law to practise as a midwife in accordance with the provisions of the  
said Act and subject to the said rules and regulations.

..... } Members of  
..... } the Board.  
.....Secretary.



She has now the right to place after her name the words "Certified Midwife," but no abbreviation in the form of initial letters (*e.g.* C.M., or, still less, C.M.B.) is permitted, or any other description of the qualification.

REGULATION, RESTRICTION, AND SUPERVISION OF THE PRACTICE OF MIDWIVES.—The Central Midwives Board has laid down certain directions to midwives regarding their persons, their instruments, and their duties. The supervision of the midwives is carried out by the local supervising authority, which in some large towns (*e.g.* in Manchester) employs an Executive Officer (who may be a qualified medical woman, as in Manchester) to see that the requirements of the Act are fulfilled, *i.e.* to visit the midwives systematically and irregularly; to inspect their homes, dresses, and bag of appliances; to see that their records are properly kept; to take charge of notifications of still-births, of deaths in women or child before a medical practitioner is called in, of puerperal fevers, and of other infectious diseases; to inspect the mode of practice of midwives as occasion offers; to record all breaches of the rules, etc.

(a) *Directions concerning the Person of the Midwife and her Appliances.*—The midwife must be scrupulously clean in every way, because the smallest particle of decomposing material may set up puerperal fevers. She must wear a dress of washable material, and over it a clean washable apron; the sleeves of the dress should be so made that they can be tucked well up over the elbows. When she is engaged to attend a labour, she ought to pay a visit to the patient at her own house before the confinement and advise as to the personal and general arrangements preparatory to the lying-in. An important rule is the following:—A midwife who is attending any case which is septic or in which there are foul-smelling discharges, must not go to another case without first changing her dress and thoroughly cleansing and disinfect her hands and forearms and such appliances as she may have had occasion to use. In Manchester it is the custom to suspend midwives in all cases when puerperal fever has occurred in their practice; but if the woman has understood and carried out the rules, the suspension is removed as soon as the necessary precautions have been taken. The midwife is directed to keep her nails cut short, and to preserve the skin of her hands from chaps and other injuries. When called to a confinement, the midwife must take with her in a bag or basket furnished with a washable lining: (1) an appliance for giving vaginal injections, a different appliance for giving enemata, a catheter, a pair of scissors, and a nail brush; (2) an efficient antiseptic for disinfecting the hands, etc.; (3) an antiseptic for douching in special cases. These requirements of the C.M.B. are hardly detailed enough; the Manchester authority's recommendations are better. They are:—The bag should have a detachable washable lining which must be kept clean, and it should contain (1) a vaginal douche tin or a syphon douche in preference to the ordinary syringe: glass nozzles should be used; (2) an enema syringe carried in a separate box: on no account must the enema syringe be used for vaginal injections, or the vaginal appliance for giving enemas; (3) a catheter, metal or glass; (4) a pair of scissors, preferably with detachable blades; (5) a clinical thermometer; (6) a nail brush and soap; (7) stout linen thread or tape for tying the cord: this should be boiled and carried in a bottle ready for use; (8) an antiseptic for the hands, perchloride of mercury; (9) an antiseptic for douching,



lysol or kresol; (10) an antiseptic for the eyes, boracic acid; and (11) as a lubricant, glycerine of perchloride of mercury (1 per 1000). The Manchester authority also instructs that the bag should be overhauled every night, that the lining should be changed once a week and at once if soiled, and the bag itself including the handle should be disinfected once a week by washing it with a solution of perchloride of mercury (1 per 1000). It seems almost a pity that a metal tin which can be sterilised is not recommended instead of a bag. The C.M.B. further instructs midwives that before touching the genital organs or their neighbourhood they must on each occasion disinfect their hands and forearms, and that all instruments and other appliances, must be disinfected, preferably by boiling, before being brought into contact with the patient's generative organs. Special rules are laid down for disinfection after attendance upon a case of puerperal fever or other infectious disease.

(b) *Directions concerning the Midwife's Duties to her Patient.*—A midwife in charge of a case of labour must not leave the patient without giving an address by which she can be found without delay; and after the commencement of the second stage, she must stay with the woman until the expulsion of the placenta, and as long after as may be necessary. In cases where a doctor has been sent for on account of the labour being abnormal, or of there being threatened danger, she must await his arrival and faithfully carry out his instructions. The midwife must wash the patient's external parts with soap and water, and then swab them with an antiseptic solution on the following occasions: (a) before making the first internal examination, (b) after the termination of labour, (c) during the lying-in period, when washing is required, and (d) before passing a catheter. For this purpose the midwife must on no account use ordinary sponges or flannels, but material which can be boiled before use, such as linen, or burnt afterwards, such as cotton-wool. No more internal examinations should be made than are absolutely necessary is the rule laid down by the C.M.B.; but it is questionable whether some effort should not be made to define more accurately what "absolutely necessary" means, for in the case of normal labours it seems hardly necessary to make more than two vaginal examinations in the first stage and one in the second. The Board does not describe how the midwife is to cleanse her hands, but some of the local supervising authorities do. I quote from one: "The midwife must prepare her arms, hands, and nails in the following manner: First, they are to be washed with warm water and soap, the nails being scrubbed with a nail brush. This must be carried out very carefully: a nail scraper would be found useful. The arms, hands, and nails must then be disinfected by washing in a basin containing perchloride of mercury solution 1 per 1000, the nails being again scrubbed. The hands should be left in the solution not less than two minutes." The placenta and membranes should be examined before they are destroyed, in order to see that they have come away entire. The midwife must remove soiled linen, blood, fæces, urine, and the placenta from the neighbourhood of the patient and from the lying-in room as soon as possible after the labour, and in every case before she leaves the patient's house.

The midwife has also duties to perform for her second patient, the child. As soon as the child's head is born, and if possible before the eyes are opened, the eyelids should be carefully cleansed. Lint dipped



in a warm solution of boracic acid is a good means of cleansing the eyes. The cord should be carefully tied in two places, and then cut with scissors which have previously been boiled. If the child be born apparently dead, the midwife is to carry out the methods of resuscitation which have been taught her. At birth the infant should be loosely wrapped in a warm blanket until the mother has been seen to and the third stage be over. It should then be examined for the detection of abnormalities. It should next be washed and dressed in front of a fire; the cord should be wrapped up in absorbent wool or iodoform gauze, and the dress should be loose but warm. In the *puerperium* the midwife should visit the patient regularly, take her pulse and temperature, ascertain if she have passed water, cleanse her external parts, and take a note of the amount and odour of the lochial discharge. The first visit should be made within twenty-four hours after the labour, and should be repeated each day for ten days. The midwife should regulate the patient's diet, and order a simple aperient when it is required. She must see to it that the nursing of the child is properly carried out. She should keep a daily record of these various matters.

In addition to special rules for the management of the mother and child, the Board lays down the following general ones:—No midwife shall follow any occupation that is in its nature liable to be a source of infection, or shall (except under the circumstances hereinafter mentioned) undertake the duty of laying out the dead. In no case must a midwife lay out the body of any patient on whom she has not been in attendance at the time of death, or a body upon which a *post-mortem* examination has been made. A midwife will not transgress this rule if, at the discretion of the local supervising authority she—(a) Prepares for burial the body of a lying-in woman, a still-born child, or an infant dying within ten days; (b) lays out a dead body in a case of non-infectious illness, provided that she is not attending a midwifery case at the time. After laying out a dead body for burial she must undergo adequate cleansing and disinfection. This rule was revised two years ago, and now reads: "A midwife may prepare for burial the body of a still-born child, provided it is not putrid, if she carries out the following precautions directly after so doing. Her hands and nails must be scrubbed for five minutes in soap and water, and then, after being rinsed in plain water, they must be disinfected in 1-1000 solution of perchloride of mercury for at least three minutes. She must put on a clean apron before attending any other case. If she does not carry out these precautions she will be held to have committed a breach of the rules. Some local supervising authorities require that no body, except as above stated, can be prepared for burial. Another revised rule is that relating to the giving of drugs. This rule (1907) reads: "No drug other than a simple aperient or ergot may be given without orders from a doctor in attendance on the case." Formerly, other drugs could be given if they were noted in the midwife's register of cases with the dose and the time and cause of their administration.

REGULATIONS REGARDING THE CALLING IN OF A MEDICAL PRACTITIONER.—The midwife is required to send for medical help in certain cases. This rule necessitates the defining of a "normal labour," but the difficulty is overcome by regarding it as one in which none of certain morbid conditions (specified below) are present. This is a definition by exclusion, but under the circumstances it is permissible. The general



rule is as follows: "In all cases of abortion, of illness of the patient or child, or of any abnormality occurring during pregnancy, labour, or lying-in, a midwife must explain that the case is one in which the attendance of a registered medical practitioner is required, and must hand to the husband or nearest relative or friend present the form for sending for medical help properly filled up and signed by her, in order that this may be immediately forwarded to the medical practitioner. If for any reason the services of a registered medical practitioner be not available the midwife must, if the case be one of emergency, remain with the patient and do her best for her until the registered medical practitioner arrives or until the emergency is over. After having complied with the rule as to the summoning of medical assistance, the midwife will not incur any legal liability by remaining on duty and doing her best for the patient." A 1907 addition to this rule was to the effect that the midwife should notify immediately to the local supervising authority those cases where the relatives refuse to obtain medical assistance. This rule about sending for medical help is to apply to five groups of cases: "(1) In all cases in which a woman during Pregnancy, Labour, or Lying-in appears to be dying or is dead; (2) in the case of a Pregnant woman, if she be a dwarf or deformed, when there is loss of blood, and when there is any abnormality or complication, such as excessive sickness, puffiness of hands or face, or dangerous varicose veins; (3) in the case of a woman in Labour at or near term, when there is any abnormality or complication, such as a malpresentation, a presentation other than the uncomplicated head or breech, where no presentation can be made out, where there is excessive bleeding, where two hours after the birth of the child the placenta and membranes have not been completely expelled, and in serious cases of rupture of the perineum or of other injuries of the soft parts; (4) in the case of a Lying-in woman when there is any abnormality or complication such as abdominal swelling and tenderness, offensive lochia if persistent, rigor with raised temperature, rise of temperature above  $100\cdot4^{\circ}$  F., with quickening of the pulse for more than twenty-four hours, unusual swelling of the breasts with local tenderness or pain, secondary post-partum hæmorrhage, or white leg; and (5) in the case of a child when there is any abnormality or complication such as injuries received during birth, any malformation or deformity in a child which seems likely to live, dangerous feebleness, inflammation of the eyes however slight, serious skin eruptions, and inflammation about the navel." A 1907 alteration of this rule had reference to perineal tears, and read as follows: "You should regard any tear of the perineum as generally *serious*, and in all cases the perineum should be carefully and thoroughly examined immediately after labour."

The Central Midwives Board has given very precise directions as to the calling in of medical help, and has enumerated, as has been shown a long list of conditions in which it is obligatory so to do; but no provision has been made for the fulfilment of the conditions so far as the medical profession is concerned, and no directions as to the remuneration of the medical practitioner are as much as named. The result has already been the development of a somewhat chaotic state of the practice. An amendment to the Act is urgently needed dealing with the question of the payment of fees to medical practitioners called in to abnormal cases. Dr. Niven, Medical Officer of Health for Manchester, in a report on the working of the Act, states that so far only two local supervising



authorities, those of Liverpool and of Cardiff, have adopted systems of payment, both purely temporary. In the meantime the following resolution has been adopted for Manchester: "That, for the present, medical practitioners, in default of payment by the patient, should apply to the Corporation under the Public Health Act, 1875, and any other powers which the Corporation may possess. The Corporation should then enquire into the circumstances of the family, and defray the fee in all cases in which the income of the family does not exceed a certain standard rate, depending on its numbers." Now, under the Public Health Act (sect. 133) payment can only be made in respect of the poorer members of the community, and so the term "poorer persons" has required to be defined. This has been done, taking the weekly wage earned as the criterion, and a maximum fee not exceeding £1, 1s. has been fixed for cases of emergency. Of course the difficult cases will be those of puerperal fever, and the probable result all over the country will be to send more of these cases into fever hospitals for treatment; this will probably turn out to be advantageous for the midwives and their patients as well as for the medical practitioner called in, to whom such illnesses must necessarily prove embarrassing, especially if he have many obstetric engagements. A practicable *modus* has been arrived at by the Council of the County Borough of St. Helens, in Lancashire, for dealing with the payment of medical men summoned to assist midwives; it will be found fully stated in the *British Medical Journal* for 23rd June 1907, pp.1548, 1549. The medical man is required to take reasonable means to secure his fee before applying to the Health Committee. The fee for attendance in all cases of urgency and danger to either the mother or the child shall be on the scale of 5s. for a visit, or £1, 1s. when operative interference is required and has been carried out. The fees are not cumulative.

NOTIFICATIONS BY MIDWIVES TO THE LOCAL SUPERVISING AUTHORITY. —The midwife must send notice to the local supervising authority if there is any change in her name or address, and she must also fill in special prepared forms notifying any one of the three following occurrences:—(a) Whenever she has advised that a registered medical practitioner should be sent for (in this form she has to state whether the case is urgent or not, and she sends one copy of it to the medical practitioner, one to the local supervising authority within twenty-four hours at the latest, and one she keeps in her own possession); (b) in all cases in which the death of the mother or of the child occurs before the attendance of a registered medical practitioner (of course this is not a death certificate, and no cause of death is stated upon it); and (c) in all cases of still-birth where a registered medical practitioner is not in attendance (a child is deemed to be still-born when, after being completely born, it has not breathed or shown any sign of life, and in the notification form it has to be stated what its sex was, whether it was full term or premature, what its condition was (macerated or not), and what the presentation was). A new duty which may now fall on the midwife as well as on a medical practitioner is the notification of all births within thirty-six hours of their occurrence. This is rendered necessary by the passing of the Early Notification of Births Act (1907), if that Act be adopted by the local authority—the council of a borough or of an urban or rural district. In the first place the duty falls on the father if he is actually residing in the house where the birth of the child takes place, at the time of its occurrence; but, failing the father, the doctor or midwife who



is present will have to carry it out, under a penalty not exceeding twenty shillings for neglecting to do so. No fee will be paid to the midwife or doctor for making the notification. In addition to making these various notifications, the midwife must keep a register of cases in the following form:—

No.....

Date of expected confinement.....

Name and address of patient.....

.....

No. of previous labours and miscarriages.....

Age.....

Date and hour of Midwife's arrival.....

Date and hour of Child's birth.....

Presentation.....

Duration of 1st, 2nd, 3rd stage of labour.....

Complications (if any) during or after labour.....

.....

Sex of infant.....Born living or dead.....

Full time or premature—No. of months.....

If Doctor sent for.....Name of Doctor.....

Date of Midwife's last visit.....

Condition of Mother then. (See Rule 11, above.).....

.....

Condition of Child then.....

Remarks<sup>1</sup>.....

.....

.....

**PENAL CLAUSES OF THE ACT.**—The local supervising authorities have power to investigate charges of malpractice, negligence, or misconduct on the part of any midwife practising within their area, and should a *prima facie* case be established, to report the same to the C.M.B.; they have also power to suspend any midwife from practice, if such suspension appears necessary in order to prevent the spread of infection; and they shall report at once to the Board the name of any midwife practising in their area convicted of an offence. There are full rules of procedure on the removal of a name from the roll, and on the restoration to the roll of a name removed; but it is unnecessary to state them here. There are three penalties, differing in severity, viz. censure, caution, and removal; and already cases have occurred under each, serving to show that the Act is no dead letter. For instance, at a meeting of the C.M.B. on 27th June 1907, one midwife was censured for not having advised that medical assistance should be sent for in a case of ophthalmia neonatorum, and another one for not having advised that medical assistance should be sent for in a case of breech presentation in a primipara. At the same meeting a midwife was cautioned as to the strict observance of the rules of the Board, and in particular as to those requiring her to notify to the local supervising authority in cases of still-birth, and when medical assistance has been sent for.

<sup>1</sup> If any drugs, other than a simple aperient, have been administered, state here their nature and dose, the reason for giving them, and the stage of labour when given.



RESULTS.—The Midwives Act of 1902 must be regarded as, on the whole, a beneficial piece of legislation. There are in it, as has been pointed out, matters requiring fuller definition, and there are others, such as the provision for the payment of medical practitioners whose services are required, which need amendment; but the result of its working cannot fail to be the saving of both maternal and infantile life and the diminution of the frequency of puerperal fever. Further, the reports of still-births and abortions by trained midwives may give statistical results of no small importance in view of the falling birth-rate and in the absence of a Still-Births Registration Act. The rules of the Central Midwives Board may be obtained from Messrs. Spottiswoode & Co., Ltd., 54 Gracechurch Street, London, E.C. Price, paper, 6d.; post free, 7d.

**Molluscum Contagiosum.**—Although for some time it has been known that molluscum contagiosum can be artificially produced by inoculation of the central core of the lesion, containing the so-called molluscum bodies, from one person to another, the causal organism has not yet been discovered. The incubation period of the disease is a long one, usually from two to four months. Juliusberg has advanced our knowledge a step further by showing that, if the molluscum bodies are pounded up with sand and bouillon in a mortar and then filtered through a Chamberland filter, the disease can still be reproduced by inoculation of the skin with the filtrate. This would lead to the supposition that the causal organism must be very much smaller than the ordinary pathogenic organisms which we know in other diseases.

REFERENCE.—JULIUSBERG. *Deutsche med. Wochensh.*, p. 1598, 1905.

**Multiple Myeloma.**—The general features of this disease, according to Parkes Weber, on whose exhaustive study the following note is based, are those of a diffuse new growth involving the marrow of the vertebræ, sternum, and ribs. Males are as, or more, often affected than females; the disease is one of later middle life. The new growth nearly always remains limited to the skeleton; deformities and fractures may occur; the cord may be compressed; anæmia results from the disturbance of the function of the marrow. In one group of cases a peculiar proteid (Bence-Jones's albumose) appears in the urine—myelopathic albumosuria (Kahler's disease).

The term multiple myeloma has been applied to a variety of new growths arising in the marrow, and not giving rise to metastases to other tissues—myelogenic sarcoma, endothelioma, plasmoma, etc.

Nothing definite is known as to the cause of myeloma. Rose Bradford draws attention to the possibility of its relationship with antecedent syphilis. The leading symptoms may be inferred from the nature of the lesion. Pain in the back or trunk, progressive deformity of the spine, bending of the sternum, fractures of ribs, and more rarely of other bones, tenderness over the bones, are among the most common. Nervous symptoms—increase of the knee-jerks, etc.—may be caused by compression of the cord. Anæmia and cachexia supervene. The anæmia seems usually to resemble a simple secondary anæmia, and abnormal cells are not, at least, prominent in the blood. Myelomatosis is always fatal, though not necessarily rapidly so. Bradford mentions cases in which the patients survived for 8 years after the characteristic albumosuria was discovered.



According to Weber, the disease may simulate osteomalacia, lumbago and rheumatism, spondylosis, spinal caries, secondary malignant disease of the skeleton, pernicious anæmia, and nephritis.

Osteomalacia tends to attack women during the reproductive period of life; the pelvis and legs are chiefly affected, and fractures are rare. In spondylosis (see SPONDYLOSIS) the rigidity is most marked in the cervical region, and there is no cachexia. In caries the curvature is more angular, and the bone disease does not involve ribs and sternum. There may be other signs of tuberculosis. Secondary new growths are more local, and a primary focus can be discovered. In pernicious anæmia there may be tenderness of the bones, but no deformity. Nephritis is only simulated where albumosuria exists. Bence-Jones's proteid, with the ordinary cold nitric acid, and Esbach's tests, give reactions like albumin.

ALBUMOSURIA.—Bence-Jones's proteid is precipitated by heating to about 58° C., and on boiling the precipitate diminishes. It also gives a precipitate with cold nitric acid (Heller's test), with hydrochloric acid, and with picric acid, which is also partially redissolved by heat. It may separate spontaneously, and give the urine a milky colour. Full details of its reactions are given by Drs. Hutchison and MacLeod in their report on Parkes Weber's case. This peculiar proteid may be present in very large amount (15 grams daily). It is believed to arise in the new growth in the marrow. Weber believes that it results from abnormal metabolism or degeneration of cells derived from the myelocyte series, but not from non-myelogenic tumour cells, hence metastatic tumours of the marrow do not give rise to Bence-Jones's albumosuria.

HISTOLOGY.—In Weber's case the marrow of all the bones was affected by a diffuse sarcoma, like growths of peculiar cells bearing a certain resemblance to the ordinary neutrophile myelocytes, but with smaller nuclei, and larger, more oxyphile, granules. In Professor Muir's opinion the tumour was formed of a special and characteristic type of cell, probably derived either from the neutrophile myelocyte or its predecessor. Christian has more recently studied the histology of 11 cases, and states that the tumour cells bear more resemblance to the bone marrow plasma cells than to the myelocytes. He regards myeloma as a true tumour, not, as Pappenheim claims, merely the marrow manifestation of a systemic disease. Sternberg divides myelomata into those with cells resembling plasma cells, and those with cells resembling myelocytes, and Weber appears to take a somewhat similar view—“(1) a growth . . . in which the bone marrow only is involved; (2) a growth in which nearly all the cells resemble small or large lymphocytes, and are probably derived from the non-granular predecessors of the myelocytes; in the second type of ‘multiple myeloma’ lymphatic glands, as well as bone marrow, may probably be affected.” Weber proposes the following scheme for the classification of the whole group of leukæmias and allied diseases:—

(a) A new growth of lymphocyte-like cells originating in the bone marrow and not overflowing into the blood-stream—myelogenic pseudo-leukæmia, myelogenic lymphosarcoma, multiple myeloma of the lymphatic type.

(b) Similar to (a), but the cells enter the blood-stream—myelogenic lymphocythæmia, acute lymphocythæmia.

(c) New growth of lymphocyte-like cells originating in lymph



glands or lymphadenoid tissue elsewhere, not overflowing into the blood-stream—lymphatic or splenic pseudo-leukæmia. Hodgkin's disease.

(*d*) Similar to (*c*), but cells enter blood-stream—ordinary lymphocythæmia.

(*e*) New growth derived from myelocytes, originating in the marrow; cells not entering the blood-stream. Sometimes associated with Bence-Jones's albumosuria—multiple myeloma (myelomatosis).

(*f*) Similar to (*e*), but with myelocytes entering blood-stream; no Bence-Jones's albumosuria—myelogenous leukæmia, myelocythæmia.

REFERENCES.—PARKES WEBER. *Med.-Chir. Trans.*, vol. lxxxvi., 1903 (gives abstracts of recorded cases, and literature).—CHRISTIAN. *Boston Med. and Surg. Journ.*, 7th May 1908 (histology, with literature).

**Myatonia Congenita.**—This name was applied by Oppenheim in 1900 to a congenital condition of localised or general atony of the muscles, especially of the legs. He conjectured that the disease was due to an arrested development of the muscles. Myatonia congenita is a rare affection, and not very many cases have been recorded. The disease is apparently always congenital, though the paresis and atony of the muscles may escape notice for a few months—until such time as a normal infant ought to be trying to hold up the head and use its muscles more freely. The chief symptom is a marked hypotonicity, with loss of the power of voluntary movement, of the muscles generally, including those of the trunk. The diaphragm, and the muscles innervated by the cranial nerves, escape. The patients can neither stand, sit upright, nor hold up the head. The palsy is not necessarily complete, and slight movement of the limbs or hands may be possible. Though they feel soft and flabby, the muscles are not really atrophied; the electrical reactions are quantitatively diminished or absent in bad cases; normal in slight ones. The tendon-jerks are abolished. The sphincters appear to act normally; swallowing is unimpaired. In Oppenheim's original description, the mental function was said to be unaffected, but in Baudouin's case there appeared to be some mental dulness, and in Spiller's case the vision was apparently very defective. Myatonia congenita is not a family disease, and it is not related to rickets, congenital syphilis, or malnutrition. Post-mortem examinations have been made on at least two cases. Baudouin found that the anterior horns of the grey matter of the spinal cord and the anterior roots were abnormally small, and that the medullation of the sciatic and other nerves was defective. The muscles showed marked changes of a retrogressive character—sclerosis, inequality of the muscle fibres, increase of the nuclei, and disappearance of the transverse striation. Spiller describes the nervous system of his case as healthy; the muscles had a hyaloid appearance, and contained much fatty tissue; the fibres were small, and the striation was indistinct. In a later communication dealing with the findings in the same case, Smith described fibrosis of the thymus and enlargement of Hassal's corpuscles, and endothelial proliferation in the thymus and in the spleen. There was also proliferation of the lymphoid elements of the mesenteric glands. Smith looks on the muscular lesion as definitely a part of the pathology of the malady, and suggests that the fibrosis of the thymus may, in some way or other, have so altered the function of that organ as to have brought about the muscular change.



DIAGNOSIS AND PROGNOSIS.—In connection with the differential diagnosis of the disease, the following maladies have to be excluded—post-rachitic pseudo-paralysis, myopathies, progressive muscular atrophy, amaurotic idiocy, and mental defect generally, associated with extreme hypotonicity and flaccidity of the muscles. Collier and S. A. K. Wilson state that while the post-mortem findings are compatible with a condition of myopathy, the following clinical facts tend to show that myatonia (or, as they would call the disease, amyotonia) is distinct from that malady:—Myatonia is not a family disease, and has not been reported in a myopathic family. In the large majority of cases it is congenital, whereas myopathy is not. There is marked flaccidity, but not local muscular wasting—in myopathy it is the reverse. Myopathies pursue a downward course; myatonia undergoes progressive amelioration, with return of the deep reflexes. The chief points to be borne in mind are that the disease is congenital, or noticed for the first time during the earlier months, and that it is not progressive. The prognosis is not necessarily bad, for some cases recover. The chief danger to life arises from the presence of bronchitis.

REFERENCES.—OPPENHEIM. *Monatssch. f. Psychiatrie u. Neurologie*, Sept. 1900.—SPILLER. *Univ. Penn. Med. Bull.*, Jan. 1905.—SMITH. *Ibid.*, Oct. 1905. BAUDOUIN. *Sem. méd.*, 22nd May 1907.—COLLIER and S. A. K. WILSON. *Brain*, p. 1, 1908.

**Nævi.**—The same freezing method with carbon dioxide as described under LUPUS ERYTHEMATOSUS has also been found very useful in the treatment of pigmented nævi. The lesions, of course, require to have a longer application of the CO<sub>2</sub> snow, so as to be frozen to a greater depth. The result is at first the formation of a bulla, which bursts and crusts over, and when the crust falls off a fine scar is left. Should one application not have completely removed the nævus, the same treatment is repeated. Besides being of use in pigmented nævi, good results have been obtained in vascular nævi. The advantages of the method are its easy application, its painlessness, and the beauty of the scar which it leaves behind.

Warts may also be readily treated by the same freezing method, the application being of such short duration, and made with such slight pressure, that no scar results.

## Nativity and Depopulation.

FALLING BIRTH-RATE . . . . .	327	<i>Treatment</i> . . . . .	331
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UNTIL the close of the nineteenth century the question of natality or the birth-rate in its relation to population had scarcely come to be pressing for any country save France; but with the beginning of the twentieth century has come the knowledge that a falling birth-rate is no longer a Gallic prerogative, but has become a common attribute of the civilised nations of the world. The tendency to limit families, and so to prepare the way for what has been called “race-suicide,” has spread from the Latin to the Teutonic and Anglo-Saxon peoples, and from Europe to America and Australia. The birth-rate of a country, formerly a matter of mild interest to the statistician and of self-congratulation to the politician, has suddenly come to be a question of



national importance, and possibly of grave anxiety, to the rulers of the land. When, from the standpoint of international relationships and of high politics, it became evident that a decline in the birth-rate of one country, with no such decline in a neighbouring state, might fairly be translated into the terms of a condition of less readiness for defence on the part of the former and of greater preparedness and capacity for attack on that of the latter nation, natality had at once secured for itself the position of a world-problem. As soon as it was realised that a fall of 1 or 2 per thousand in the birth-rate meant, for a large nation like France, the lack in the next generation of citizens capable of military service equal in number to an army corps, the gravity of the question of natality could no longer be ignored.

No sooner were the decennial census returns for Great Britain published than it became evident that there had taken place a serious fall in the birth-rate of this country. To this marked decline Dean Freemantle drew attention in the *Times* (vide *Brit. Med. Journ.*, i. for 1901, p. 1630), and on it Stead commented in the *Review of Reviews* (xxiv. p. 14, 1901); the matter had clearly passed out of the sphere of medicine, and had become one of general interest. The Dean of Ripon pointed out that in a quarter of a century (viz. between the years 1875 and 1900) the birth-rate of the United Kingdom had fallen from 35 per thousand to 29 per thousand. For the population of  $41\frac{1}{2}$  millions inhabiting these islands there was, therefore, now an annual deficiency (at the present rate) of 249,000 babies. This was a more rapid decline than had taken place in France, where the process had been slower and longer in action. In the census returns the effect of this lowered natality was masked to some extent by the fall in the death-rate; but, of course, this could only be a temporary hindrance to the coming about of the ultimate result of a falling natality, viz. depopulation, for death was inevitable although it might be postponed for a decade or so, while births might be reduced to zero at the will of the people. Immigration, also, might mask the effect of a falling birth-rate, but it could hardly be regarded as diminishing the seriousness of the decline from a national or racial point of view. Since 1901 evidence of a declining natality has been accumulating, not only in Great Britain, but also in Australia and in the United States of America; and within the past few years the birth-rate of Germany, not excluding Prussia, has shown the same downward trend, for in 1876 it stood at 41 per thousand, and it fell to 33·1 in 1906. In Berlin, in 1876, natality was 45·4 per thousand, and in 1905 it was 24·6! Within the past year (1908) there has been evidence of an upward tendency in the birth-rate of France; the hope may be expressed that as the fall began in this country some years ago, with the other nations following suit, so, now, the rising again of the rate may extend to other countries than France. The somewhat extensive literature which has grown up round this interesting, but also alarming, tendency in modern life will be found at the end of the present article (vide p. 332).

The *causes* of the falling birth-rate are not far to seek, however difficult it may be found to check them. It may be that one of these causes is the greater frequency of sterility due to syphilis and gonorrhœa in the male as well as in the female parent; it is possible that alcoholism and drug-taking have acted in a prejudicial fashion upon pregnancy; it is generally admitted that the crime of producing abortion is becoming distressingly common; and there are other influences, such as over-



eating, and especially the use of an exclusively meat diet, which may be at work (B. P. Watson, *Brit. Med. Journ.*, i. for 1907, p. 193); but the great causes of a lowered natality are not to be found among these things. Ballantyne, in his Presidential Address to the Edinburgh Obstetrical Society in 1906 (*Trans. Edin. Obstet. Soc.*, xxxii. p. 21, 1907), put the matter thus: "The falling of the birth-rate was not due to less knowledge or less skill in the obstetricians of the day, or to want of training of the midwives and monthly nurses, or to the neglect of chloroform or the forceps, or to the excessive use of these means of relieving pain and hastening the second stage of labour, or, indeed, to any other thing which lay in the power of the medical man to do or to leave undone. The causes lay deep among the roots of the somewhat artificial conditions of the sexual relationships in modern society. Renan had said: 'The spread of an enlightened selfishness is, in the moral world, a fact of the same nature as the exhaustion of coal-fields is in the physical world; in each case the existing generation is living upon and not replacing the economies of the past,' and his words applied very exactly to the enlightened selfishness which was the root-cause of the falling birth-rate. The era of personal comfort first, and at any cost; the age of marriages made late in life, because the entrants upon the matrimonial state wished to begin, not where their parents began, but where they were prepared to leave off; the period of frequent holidays and expensive amusement—that epoch could hardly be described as other than 'selfish,' although it might be doubted whether it deserved the honour of being entitled 'enlightened.' In any case, such an age was not one in which frequent child-bearing was likely to be thought of with favour, or carried through with enthusiasm. If there was ergophobia in the one sex there was maieusophobia in the other." There can be no doubt that voluntary sterility by the artificial prevention of conception is the great factor in the causation of the falling birth-rate to be observed in civilised lands; the means of checking pregnancy are now better known, and their use is apparently much more frequent now than formerly, and so families are limited to two or three children, or marriage is rendered absolutely sterile from the very beginning (*Brit. Med. Journ.*, i. for 1906, p. 269). It may be, and has been, argued that such practices indicate an increased sense of "the responsibilities of parenthood, and an awakening of the conscience of the individual to a sense of the wickedness of bringing into the world children whom their parents are not able either to feed or educate properly"; but a ready answer to this argument is found in the fact that it is in the well-to-do classes, and not among the poor and thriftless, that the fall in the birth-rate is most evident. The fall is all the more serious on this account, for, as Mr. Stead puts it (*Review of Reviews*, xxiv. p. 14, 1901), perhaps somewhat strongly, "if the moral and intelligent classes reduce their families to ones and twos, they hand over the future to the litters who are spawned every year by the thousand by parents who have as little sense of the responsibilities of fatherhood and motherhood as the fishes in the sea." It is surely a curious modern development of Malthusianism by which the educated, intelligent, and successful classes of the community are abrogating their privileges of reproducing their like, and are leaving the replenishing of the earth to others; there is little evidence that the world contains too many of the "fit," but there is more than one sign that it is inhabited by masses of the "unfit," and it is the propagation of the former, and not the increase of the latter, that is to be desired. Eugenics is a very



interesting branch of science, and it has high aims, which are the propagation of the fit and the elimination of the unfit in reproduction; but it comes upon the stage of the world's progress at an unpropitious hour, and will have a hard battle to fight. It is no doubt true that if "the babies are to be few, they ought to be fine," in other words, if the birth-rate must fall, then the progeny of the best parents ought to be preserved at all costs; but, unfortunately, it is precisely in what may be called the best stock that the restriction of the family is most evident. Further, there is no certain evidence that the declining birth-rate coincides with improvement of social conditions and is part of the economy of Nature (*Brit. Med. Journ.*, i. for 1906, p. 279).

The great cause, then, of the falling birth-rate is the voluntary restriction of the size of the family, the seeking for a sort of "voluptuous sterility"; but there is a subsidiary cause which is of some importance, the elevation of the age when marriage is entered into. Obviously, if a man and woman marry at the ages of forty and thirty-five their chance of having a large family is much less than if they married at twenty-five and twenty. Dumont (*Bull. et mém. Soc. d'anthrop. de Paris*, 5 S. iii. p. 248, 1902) has worked out the effect of opsigamy or late marriage upon the birth-rate of France. Of the whole male population of that country between the ages of 18 and 45, 45·8 per cent. were unmarried, while of the whole female population between the ages of 15 and 40, there were 44·9 per cent. unmarried. "What mysterious obstacle was it that prevented the 44 per cent. falling figuratively into the arms of the 45 per cent.?" (Edit., *Brit. Med. Journ.*, i. for 1903, p. 267). Dumont believed that the answer was to be found in the state of society which kept a son so long dependent upon his parents. "Businesses and professions were tardily lucrative, and the parasitic stage of life was lengthened"; further, there was the "dotal" or dowry difficulty, for French parents with their sons on their hands were unable to provide dowries for their daughters; third, there was the military service which France demanded of her young men; and, fourth, there was the example and influence of the Roman Catholic Church with its celibate clergy and its unmarried nuns. Some of these reasons are inoperative in this country, but others are in action; and there is doubtless another cause, which is touched upon by Snyder (*Journ. Amer. Med. Assoc.*, xlix. p. 363, 1907) as delaying marriage, viz. the dread of maternity fostered in the minds of unmarried girls by the tales of matrimonial disease and disaster, and the irksomeness of caring for infants, told them by their married sisters.

The fall in the birth-rate is in itself a serious phenomenon, but it is made still more grave by certain other occurrences which have been called its "aggravations" (*Trans. Edin. Obstet. Soc.*, xxxii. p. 17, 1906-7). The first of these is the almost stationary character of the infantile death-rate. Hygiene has greatly increased the chances of survival among individuals between the ages of 5 years and 25 years, and it has added a little to the length of the life of the aged, but it has been disappointingly ineffectual in checking the high death-rate among new-born infants. To quote from the *Report of the National Conference on Infantile Mortality* (p. 99) held in London in 1906: "In the twenty years ended 1874, we find that out of every 1000 children born alive in England and Wales, 153 never completed their first year, while in the twenty years ended 1904, the ratio was 148 per 1000." Here, then, is the first aggravation of the decline in natality: fewer babies



are being born, and they are dying off almost as rapidly during the first year of life as they did in the past. The second aggravation is our ignorance, in this country at least, of the still-birth-rate and of the abortion-rate; national statistics are silent on these matters; but there is an uneasy feeling in the medical mind, resting upon the figures obtained in some localities by trained midwives and others, that these rates are increasing and not diminishing. In other words, out of the already fewer pregnancies more are ending in abortions and in still-births than formerly. A third aggravation is found in the increasing number of premature labours and in the infantile mortality following them, so that alongside the falling birth-rate is a depreciation in the death-resisting powers of the offspring due to an early termination of antenatal life and a premature entrance into the more exacting environment of the neonatal state.

Much has been written regarding the *checking of the falling birth-rate*, but, so far, little has been effected. Perhaps the first and most obvious step has already been taken in giving publicity to the facts of the case. The constantly recurring head-line in the newspapers—"the falling birth-rate" or "further decline in the birth-rate"—will in time impress the public mind and perchance awaken the national conscience. It would be well if such notices were accompanied by comparisons with the figures of past years and by a calculation of the annual deficiency (so to speak) in babies which the lowered rate brings with it. On the other hand, there is possibly the risk that such notices in the papers may make known to married people the hitherto unsuspected existence of means of preventing large families and so lead to the still more extensive employment of "checks." This danger, however, must be faced and the truth told. Perhaps, after all, the risk is not very great; for there are other agencies (with less worthy motives) at work disseminating information; and it is well that the facts should reach the people, without accompanying incitements to initiate the parents who have abandoned the responsibilities, not to speak of the happiness, of parenthood. Then, again, it would be well if the medical profession defined carefully the morbid consequences (if there are such) attaching to marriages voluntarily made sterile, and let these results be known to their patients. Information of the same kind might be given to the public by midwives and monthly nurses.

There are ways in which an upward tendency in the birth-rate might be excited and fostered. There are, for instance, the legislative and fixed devices of giving abatement of income-tax to all fathers having families of more than 3 or 4 children or of offering grants to the individual children in large families. In some way or other there might be an "endowment of motherhood" (*Brit. Med. Journ.*, ii. for 1906, p. 1051). The evolution of a healthy public opinion on the subject could not fail to do good. Then, if it became clear that the birth-rate was rising, the preaching of eugenics would doubtless help to "improve the breed" by encouraging procreation by the fit and preventing it among the unfit. But it is to be feared that we are yet far from the days of a birth-rate going up by leaps and bounds, for it is doubtful whether any of the means suggested will prove efficacious in stopping the downward trend for some years to come.

But there are other ways in which the evil effects of a falling birth-rate may be lessened: we can attack the aggravations of diminished natality. We can try, for instance, to conserve the lives *in utero* which,



under present circumstances, run so many risks of never coming to the birth; in other words, we can endeavour to check abortions and still-births. The laws of antenatal life and health are beginning to be better understood, and it is known that parental alcoholism, that improper feeding of the pregnant woman, and that certain trades with their toxicological risks are specially dangerous to the unborn infant. The registration of abortions and still-births, and perhaps of pregnancy (*Brit. Med. Journ.*, ii. for 1907, p. 425), the prohibition of women working at certain trades during their pregnancies, the provision of pre-maternity hospitals for women suffering from the diseases of pregnancy, and possibly, as Havelock Ellis suggests, the establishment of a "State Department for the Unborn" might achieve much in preventing the present appalling wastage of antenatal life. Then, again, the prevention of eclampsia, of hyperemesis gravidarum, of chorea of the pregnant, and of other grave complications of gestation, founded upon a right understanding of the causation of these states, would save many foetal lives. The keeping alive of the prematurely-born infant by the perfecting of incubators and the devising of suitable methods of feeding would, of course, tend to lessen the high neonatal death-rate, and so for a time counteract the falling birth-rate. Further, and of the greatest importance, the spreading of knowledge as to the proper care and feeding of all newborn infants among all classes of the community could not fail to be most beneficial; the Huddersfield experiment might well be carried out on a large scale with advantage. The early notification of births now being widely adopted cannot do aught but good in enabling health visitors and others to get in touch with infant life before the ignorance or culpable carelessness of parents of a certain class convert it into early death. So, while it may not be possible yet to check the tendency to limit families, it may be quite practicable to save much life that is at present lost and so prevent the relative depopulation of our land and its fall to a secondary place among other nations.

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**Nephritis, Treatment of.**—In the dietetic management of nephritis the modern tendency is to favour reducing by every possible means the nitrogenous constituents of the food in acute cases, but to allow a more liberal diet than was formerly approved of in chronic parenchymatous and interstitial nephritis. Dr. J. M. Finny, in a recent paper on the subject, adopts the view of those who hold that it is a mistake to order milk *ad libitum* in acute nephritis; milk contains too much albumen and too much water—it is, therefore, a doubtful practice, as well as unscientific, to endeavour, on the one hand, to save the kidney, whose function of secreting water by the glomeruli is in abeyance, and, on the other, to order four or five pints of milk in the twenty-four hours, to add to the already overfull circulation.

In very acute cases von Noorden believes it is best to give no nitrogen—nothing but sugar and water and fruit juice for from three to eight days at a stretch (often 200 to 300 grams of sugar daily). For less acute cases, milk combined with some such farinaceous food as arrowroot, cornflour, Benger's food, etc., should be given, and in every instance cream and sugar should be added. Von Noorden gives a sample of a daily menu containing a minimum of protein, yet possessing high nutritive value, as follows:—Milk, 150 grams; cream, 375 grams; rice, 50 grams; rusk, 50 grams; butter, 50 grams; sugar, 20 grams; it contains 2900 calories. Such a diet is suitable for acute nephritis. In convalescence the milk is to be increased to 2½ litres, and white bread, cereals, cream cheese, and a little egg and meal are added. Free libations of fluid, given with the idea of flushing out the kidneys, do more harm than good until the excretion of urine is fully re-established. In chronic nephritis, whether interstitial or parenchymatous, von Noorden allows a daily ration of 6 to 7 ozs. of meat, either red or white, in addition to the above. Any considerable deficiency of protein affects the general strength and nutrition of patients suffering from



Bright's disease, even though the excretion of albumin may be temporarily diminished. He advises, however, that there should be an occasional interpolation of a period (7 to 14 days) of strict non-proteid diet.

CHLORIDE-FREE DIET.—Cases of acute and chronic parenchymatous nephritis, especially the latter, accompanied by dropsy, often improve rapidly on a diet free from chloride of sodium. The excretion of urine rises, the œdema disappears, and, coincidentally therewith, the albumin in the urine diminishes. The introduction of this method of treatment—"dechlorination"—is due chiefly to the work of Widal and Javal, who have thrown much light on the salt-interchange of the body and the nature of œdema.

Contrary to popular belief, there is no evidence that the almost universal practice of adding salt to food is necessary to health. Among uncivilised races there are many exceptions to the rule, and alleged instances of ill-health following privation from salt break down on scrutiny. The actual bodily requirement of salt, as estimated by the quantity excreted by subjects who are fasting, is about  $\cdot 6$  gram daily, and this loss is more than replaced by the amount—1.5 to 2 grams—naturally present in an average mixed diet. In health, the body remains in a state of chloride equilibrium, the amount eliminated daily corresponding with what is ingested. All the tissues of the body are bathed in saline fluid, and it is imperative that the osmotic pressure, or concentration, of this should remain constant. The negative action of physiological salt-solution on the tissue cells as compared with the deleterious effects of stronger or weaker solutions is an illustration of this. Variations in the quantity of salt in the body must therefore be compensated for, and this is done, partly by the retention of enough water to keep it in solution of normal strength, and partly by the eliminatory action of the kidneys. If a healthy man be given a diet free from added salt he continues for several days to eliminate a quantity exceeding that ingested, losing weight the while; at the end of that time chloride equilibrium—*i.e.* output equals intake—is restored and the weight remains stationary. The addition of a fixed ration of salt causes the weight to rise again, and there is a corresponding retention of chloride before equilibrium is re-established. From such experiments it has been shown that about 12 grams of sodium chloride and 1.5 to 2 kilos of water represent the floating quantity lost by a normal adult in the process of dechlorination. Owing to the ability of the kidneys to excrete chlorides freely, large doses are tolerated in health, yet the power of even the normal organ has its limits, and the habitual consumption of quantities of salt in excess of the renal capacity may, *per se*, lead to retention of salt, and œdema from the excess of water required to keep it in isotonic solution.

In many forms of nephritis the kidneys become impermeable to sodium chloride, salt is retained in the tissues, and dropsy ensues. Patients with Bright's disease, swollen with dropsy, often lose weight steadily and recover from their dropsy when put on a diet containing no added salt. On adding salt the weight rises, and the œdema disappears. In such a case it will be found that on each addition or subtraction of salt with its rise or fall in the weight curve, there is a definite level at which visible œdema makes its appearance. Widal calls the period during which the weight is rising towards this point the *pre-œdematous period*; it represents the accumulation of fluid in



the viscera. The kidneys, like the other viscera, suffer from the effects of interstitial œdema, and there is reason to believe that in curing this renal œdema we break a link in the chain of a vicious circle, in which the renal inadequacy produces a lesion of the kidney which still further impairs the efficiency of the organ. Thus, in removing œdema by dechlorination we are doing more than merely treating a symptom. Whatever be the precise explanation, it is certain that a dropsical patient, whose kidneys are impervious to very small quantities of chloride, may, after dechlorination has abolished the dropsy, regain part, at least, of his power of eliminating salt, and along with this there may be a marked diminution in the albuminuria. Dechlorination is said to be occasionally attended by nervous symptoms resembling those of uræmia; they are, however, rare and temporary. The practice of dechlorination is simple, and, contrary to what might be anticipated, patients do not rebel against being deprived of salt. Milk contains about 1·6 grams of salt per litre, which is equivalent to about 5·6 grams in an ordinary daily ration. Although this considerably exceeds the proportion naturally present in a mixed diet, it is much inferior to the quantity habitually consumed as added salt (15 to 20 grams), and probably some of the efficacy of milk in the treatment of nephritis is as much due to its comparative poverty in chloride as to any special attribute of its chlorine content. In strict dechlorination recourse must be had to a mixed diet, which may be selected from among the following, cooked without the addition of salt:—Fresh meat of all kinds, fresh-water fish, eggs, fresh butter, cream, potatoes, farinaceæ generally, sweets, vegetables, and fruit. The only article which requires special fabrication is bread; as ordinarily baked it contains from ·8 to 1 per cent. of salt; this, therefore, must be omitted. Home-made scones, free from salt, may be used instead. Soups, sea-water fish, all forms of salted or preserved foods, cheese, and milk, are proscribed. In practice, Widal allows from  $3\frac{1}{2}$  to 7 ozs. of meat daily, with cereals, eggs, etc., as the appetite demands.

Patients subjected to dechlorination should be kept in bed until the weight ceases falling and becomes stationary. Should dehydration be slow, it may be assisted by diuretics, particularly theobromine. To gauge the amount of fluid (and chlorides) lost, daily weighing is essential, and replaces chloride estimations.

Biancardi (*Ann. di ostet. e ginec.*, ii. for 1905, p. 641) and Cramer (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiii. p. 437, 1906) reported cases of parenchymatous nephritis in pregnancy which improved markedly on chloride-free diet.

Dechlorination has been successfully employed in all forms of dropsy, cardiac and hepatic as well as renal, in œdema of the legs from exertion, phlegmasia, etc. The rationale of its action is the same in all such cases.

DECAPSULATION OF THE KIDNEYS (Edebohl's operation) has been employed in the treatment of nephritis, but the operation is now generally discarded (see PUERPERAL ECLAMPSIA, p. 163).

URÆMIA.—The pathology of uræmia still remains to be elucidated. The general impression at the present time is that it cannot be explained simply on the assumption that it is due to retention in the blood of substances which should be eliminated by the kidney, but that it is rather due to some abnormal metabolic process. Some recent work by Golla suggests that its phenomena may be due to the presence of



trimethylamine, which is present in excess in the blood of nephritic patients. The precursor of trimethylamine is probably lecithin. Widal ascribes some of the symptoms of uræmia—particularly those affecting the nervous system—to retention of chlorides. His view is that both the chlorides and urea may be retained in some cases; in others, the chlorides only; in others, the urea. The percentage of urea in the blood is invoked to distinguish these; if it is below 1 gram per litre the toxæmia is due to chlorides, if 3 to 4 grams per litre, it is probably due to the urea. The chief signs of azotæmia are gastrointestinal disturbance, anorexia, prostration, and torpor.

To Widal and his school œdema is explained solely as due to salt retention. This, however, is too one-sided a view. Chloride retention undoubtedly does lead to œdema, but, as von Noorden says, "we should be greatly wanting in critical acumen were we to suppose that this is the only, or even the most important, factor in the production of the condition, and, in consequence, to regulate the entire diet of renal patients on 'osmotic principles.'"

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**Ochronosis.**—This extremely rare disease was first described by Virchow in 1866, but comparatively little had been added to our knowledge of it until 1906. Ochronosis is a condition of widely diffused melanotic pigmentation, the cartilaginous and fibrous structures throughout the body being chiefly affected. It does not seem to occur in persons under middle age, and is not in itself a fatal malady. According to Osler the patients usually seek medical aid on account of pigmentation, of passing discoloured urine, or of arthritis, hence the disorder may be described under these three heads. 1. *Pigmentation.* During life the pigmentation is usually most evident in the sclerotics and ears; sometimes it also affects the hands, especially about the knuckles, and the skin of the face. Apparently there is less tendency for covered parts of the skin to suffer. The pigmentation differs from that of Addison's disease and argyria; it varies from a brown to a pure black, while in some cases the ears and fingers have a steely iridescence. Pick describes the aspect of a patient with ochronosis as grotesque: her face was coffee-brown, with deep brown spots round the eyes; the ears were iridescent steel-blue; and the hands, a dull slate. The pigmentation of the eyes is almost pathognomonic (Osler). There are symmetrically disposed brown or black triangular areas on each eye, bounded by a narrow border of normal sclera. On post-mortem examination the cartilages, tendons, ligaments, inner coats of arteries, valves of the heart, fascia, and even the kidneys and other viscera are yellow, brown, smoky, or inky black. 2. *Urine.* In a number of cases melanuria has been observed. Sometimes the urine is dark when passed; in other instances it turns black on exposure to the air. 3. Chronic arthritis affecting various joints has been described in several of the reported cases.

**PATHOLOGY.**—The nature of ochronosis is obscure. In several cases there is definite proof that the patient suffered from alkaptonuria (*Encyclopædia Medica*, XIII., p. 116), a congenital condition in which the urine contains a copper-reducing substance and turns black on exposure



to the air. In another group of cases there is presumptive evidence of chronic carbolic acid poisoning. Such, for example, have been reported by Pick and Reid, in which the existence of chronic ulcer of the leg had led to the continued application of carbolic acid dressings over long periods of time. Here the urinary discoloration is probably due to carboluria. In yet a third series of cases the black urine was due to neither of the above causes; these may have been examples of true melanuria. Melanotic pigments in general are derived from tyrosin by the action of a ferment named tyrosinase, and Pick suggests that this ferment may also be able to convert into melanin the hydroxyl aromatic substances which exist in the circulation of alkaptonuric patients (endogenous ochronosis) as well as the phenol absorbed in chronic carbolic poisoning (exogenous ochronosis). Garrod states that while alkaptonuria and chronic carboluria may cause ochronosis they cannot be the only conditions producing this curious pigmentary anomaly.

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**Optic Thalamus Syndrome.**—The symptomatology of lesions of the thalamic region was described by Déjérine in 1903, and more recently Hartenberg has given a *résumé* of the condition, of which what follows is a brief epitome. The essential symptoms of the "thalamic syndrome" are:—Hemianæsthesia, pain on the anæsthetic side, slight hemiplegia, hemiataxia, and athetosis. Certain accidental symptoms, of which hemianopsia is the most important, may also occur; these, however, are due to the involvement of structures adjacent to the thalamus, and are not part of the symptom-complex. The thalamic syndrome is produced by a lesion which destroys the postero-external division of the external nucleus, together with part of the middle and internal nuclei and the corresponding fragment of the internal capsule. Hemianopsia is caused when Gratiolet's fibres are also implicated by a lesion of the posterior and inferior part of the thalamus. The onset is usually insidious.

The *hemianæsthesia* involves superficial sensibility, deep sensibility, the muscular sense, and the stereognostic sense. There is much less disturbance of superficial sensibility, whether to touch, pain, or temperature, than of the others. The *pain* on the anæsthetic side is intense; it is superficial rather than deep, and is continuous, with occasional paroxysmal exacerbations. It is due to irritation of the fibres of the internal capsule. The *hemiplegia* is very slight; there is neither atrophy nor contraction of the muscles. The reflexes are exaggerated or normal; Babinski's sign is inconstant (absent—Déjérine). *Hemiataxia* and *athetoid movement* usually occur; they do not seriously affect voluntary motion.

The thalamic symptom-complex, therefore, is due to a lesion of the sensory path, which at the same time just implicates the pyramidal tract. The diagnosis is not easy, because a very similar train of symptoms may be brought about by a lesion of the same tracts lower down in the brain and pons. When this is the case, however, some of the cranial nerves will also be affected—the ocular or facial especially. In the thalamic syndrome these are spared.

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## Pancreas, Diseases of the.

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SINCE Mr. Mayo Robson contributed the article on diseases of the pancreas to the *Encyclopædia Medica* (Vol. IX. p. 70) he has, in collaboration with Dr. Cammidge, published a compendious treatise on the same subject, which has added enormously to our knowledge of the affections of this organ, and has to some extent revolutionised our methods of treatment. In the department of diagnosis, particularly, we owe to Mr. Robson and Dr. Cammidge the introduction of several new methods.

DIAGNOSIS OF PANCREATIC DISEASE.—Very great assistance in diagnosis may be obtained by a careful pathological examination of the urine and of the fæces.

(1) *Fæces*.—In many instances the condition of the stools is almost characteristic of pancreatic mischief. The motions are bulky, pale, greasy, and offensive; though soft and frequent, they are not liquid. Patients, however, often complain of “diarrhœa,” but enquiry will elicit the fact that the stools are not really liquid. The motions contain undigested fat and much fibre. This condition of affairs is more common in pancreatitis than in malignant disease of the organ, probably because in cancer the appetite is usually impaired, whereas in inflammatory affections it is more or less undisturbed, at any rate during the early stages. Fatty stools have long been recognised as symptomatic of pancreatic affection; the steatorrhœa occurs independently of jaundice, and is directly due to the pancreatic lesion. When fat is very abundant it may be recognised by the naked eye as an oily exudate, but if full advantage is to be taken of the occurrence of steatorrhœa as a symptom of disease of the pancreas a quantitative analysis of the fæces is required.

*Method*.—Mayo Robson and Cammidge recommend the following method:—“Two clean, dry, Schmidt-Stokes milk tubes, labelled A and B, and provided with a 10 c.c. mark, are taken, and into the lower bulb of each is introduced an accurately weighed quantity (about half a gram) of the finely powdered fæces, that have been dried to a constant weight in a water-bath. The residue on the watch-glass used for weighing, and on the sides of the short-necked funnel with which the powder is introduced into the tube, is washed down with a fine jet from a wash-bottle, which for the A tube contains hydrochloric acid (1:3), and for the B tube plain water. The sides of the tube are also washed until the whole of the sample is collected in the lower bulb and the 10 c.c. mark is reached. The A tube is then heated in boiling water for twenty minutes, occasionally rotating it so as to well mix the contents. After cooling, both of the tubes are filled to the 50 c.c. mark with ether, securely corked, and inverted forty times, taking care that the whole of the solid material runs through at each turn. Each tube is then rotated between the hands, and allowed to stand for half an hour or more, in order that the solid residue may be collected into the lower bulb. Considerable care is necessary in carrying out this part of the process in some instances, or a perfectly clear supernatant layer of ether, free from solid particles, is not secured. With a pipette, exactly 20 c.c. of the clear ethereal extract are drawn off from each tube and delivered into two CO<sub>2</sub> flasks of known weight, the amount of ether left in the tubes



being noted. The ether in the flasks is then evaporated, the residue dried on the water-bath, and the flasks again weighed. From the amount of extract yielded by 20 c.c. of ether, and the quantity of ether left in the tubes, the total amount yielded by the weight of dried fæces used may be calculated, and from this the percentage in the stool determined. The result from the A-tube gives the total fat in the fæces, including the neutral fats, free fatty acids, and combined fatty acids, or soaps, since the latter will have been decomposed by being boiled with the hydrochloric acid and thus rendered soluble; that from the B-tube represents the neutral fats and fatty acids only, as the soaps will remain undissolved by the ether: the difference between the two will therefore give the proportion of saponified fat present. Other substances in the fæces soluble in ether, such as cholesterin, lecithin, cholic acid, and pigments, are included in the estimates, but as the quantity is small it does not appreciably affect the results. For convenience of reference we shall speak of the yield from the A-tube as 'total fat,' that from the B tube as 'neutral fat,' and the difference between the two as 'fatty acid.'

When the functions of the pancreas are seriously interfered with, the amount of "total fat" in the stools is usually excessive. There is also a disturbance of the normal ratio between "neutral fat" and "fatty acids," the former, instead of the latter, being in excess. Robson and Cammidge give the following average figures:—

	Total Fats.	Neutral Fats.	Fatty Acids.
Normal, per cent. . . . .	21	11	10
Malignant disease, per cent. .	77	50	27
Chronic pancreatitis, per cent. .	50	32	18

In some cases of undoubted pancreatic disease there is no excess of fat in the stools. This may be due to (1) the food containing an unusually small proportion of fat; (2) the fat in the food being of a readily digestible kind—*e.g.* milk; (3) the action of the fat-splitting ferment in the stomach. An excess of fat may sometimes be detected microscopically, but this method of examination is far inferior as a diagnostic aid to chemical analysis.

In estimating the significance of steatorrhœa, the following facts should be taken into consideration:—(1) An excess of fat in the stools may be due to ingestion of food containing abnormal quantities of fat. (2) It may also be due to disease of the intestine, etc., interfering with the absorption of fat—*e.g.* tuberculosis. (3) Even if jaundice be present, an excess of neutral fat over fatty acids points to some interference with the fat-splitting action of the pancreas. (4) Disappearance of the steatorrhœa on the administration of a preparation of pancreas confirms the diagnosis of pancreatic mischief.

Other signs of pancreatic disease afforded by the examination of the stools are—(1) The presence of large numbers of undigested muscle fibres (see DIGESTION, p. 152, examination of the gastric functions, Schmidt's diet). (2) The application of the test for stercobilin may differentiate between jaundice due to cancer of the head of the pancreas and jaundice due to chronic pancreatitis or gall-stones. In the former stercobilin is absent, or present only in faint traces; in the latter, though less than normal, it is distinctly present.

The test for stercobilin advised by Cammidge is the following:—  
"The solid residue from the B-tube [*supra*] can be used. . . . For this



purpose it is filtered off, extracted with acid alcohol, the extract neutralised with ammonia, and mixed with an equal quantity of 10 per cent. zinc acetate in alcohol. The precipitate that forms is removed by filtration, and the clear filtrate examined with a lens, against a black background, for the green fluorescence that indicates the presence of stercobilin. The intensity of the colour varies with the amount of pigment, so that by always using approximately the same proportion of faeces and of the reagents any marked variation from the normal can be detected."

(2) *Urine*.—*Cambridge's "Pancreatic Reaction."*—The original method of performing the test, as described by Cambridge in 1904, has undergone more than one modification, and has been superseded by the improved or "C-reaction," the technique of which is described by Robson and Cambridge in these words:—

"A specimen of the twenty-four hours' urine, or of the mixed evening and morning secretions, is filtered several times through the same filter-paper. If it is found to be free from sugar and albumin, and is acid in reaction, 2 c.c. of strong hydrochloric acid (sp. gr. 1.16) are mixed with 40 c.c. of the clear filtrate, and the mixture gently boiled on a sand-bath, in a small flask, fitted with a funnel condenser. After ten minutes' boiling the flask is well cooled in a stream of water, and the contents made up to 40 c.c. with cold distilled water. The excess of acid is then neutralised by slowly adding 8 grams of lead carbonate. After standing for a few minutes to allow of the completion of the reaction, the flask is again cooled in running water, and the contents filtered through a well-moistened, close-grained filter-paper until a perfectly clear filtrate is obtained. The acid filtrate is then well shaken with 8 grams of powdered tribasic lead acetate, and the resulting precipitate removed by filtration, as clear a filtrate as possible being secured by repeating the filtration several times if necessary. Since the large amount of lead now in solution would interfere with the subsequent steps of the experiment, it is removed, either by a stream of sulphuretted hydrogen, or, what we have found to be equally satisfactory and less disagreeable, by precipitating the lead as a sulphate. For this purpose the filtrate is well shaken with 4 grams of powdered sodium sulphate, the mixture heated to the boiling-point, then cooled to as low a temperature as possible in a stream of cold water, and the whole precipitate removed by careful filtration. Ten cubic centimetres of the perfectly clear, transparent filtrate are taken and made up to 17 c.c. with distilled water; it is then added to .8 gram phenylhydrazin hydrochlorate, 2 grams of sodium acetate, and 1 c.c. of 50 per cent. acetic acid, contained in a small flask fitted with a funnel condenser. The mixture is boiled on a sand-bath for ten minutes and filtered hot through a small filter-paper, moistened with hot water, into a test-tube provided with a 15 c.c. mark. Should the filtrate fall short of 15 c.c., it is made up to that amount with hot distilled water, the added water being well mixed with the fluid by stirring with a glass rod, but in our own work we find that any addition is rarely necessary, as, with a little practice, it is possible to so regulate the boiling that the final result almost always comes out at between 15 and 16 c.c.

"In well-marked cases of pancreatic inflammation a light yellow, flocculent precipitate should appear in a few hours, but in less characteristic cases it may be necessary to leave the preparation overnight before a deposit occurs. Under the microscope the precipitate is seen



to consist of long, light yellow, flexible, hair-like crystals arranged in delicate sheaves, which, when irrigated with 33 per cent. sulphuric acid, melt away and disappear in ten to fifteen seconds after the acid first touches them. The preparation must always be examined microscopically, as a small deposit may be easily overlooked with the naked eye, and it is also difficult to determine the exact nature of a slight precipitate by microscopical examination alone.

"To exclude traces of sugar, undetected by the preliminary reduction tests, a control experiment is carried out by treating 40 c.c. of the filtered urine in the same way as that in the test just described, except that it is not boiled with hydrochloric acid. Any albumin that may be present in the urine is removed, previous to commencing the test, by faintly acidulating, boiling, filtering off the albuminous precipitate, cooling, and making the specimen up to its original bulk with distilled water. The urine employed for the experiment should be fresh, and not have undergone fermentative changes. If alkaline in reaction, it should be made distinctly acid with hydrochloric acid before the test is commenced. Any dextrose that may be present can be removed by fermentation *after* the urine has been boiled with the acid and the excess neutralised."

This "C-reaction" is slightly more complicated than the earlier tests advised by Cammidge. It is said, however, to be more reliable, in that the result is more absolute, and less dependent on the personal equation of the observer. It may be added that the manipulations sound more troublesome than they actually are, and that with a little practice the test can be readily enough performed by anyone with the aid of a little simple apparatus. A positive reaction may be expected in all cases in which active inflammatory changes are going on in the pancreas. Acute pancreatitis can thus be distinguished from intestinal obstruction, and other conditions, while chronic pancreatitis associated with obstruction of the common duct can be distinguished by this means from obstruction of the duct due to gall-stones, etc.

In the diagnosis of chronic pancreatitis from cancer of the organ the test is also of value. In about three-fourths of all cases of malignant disease the reaction is negative, while in the remaining fourth it is positive. The positive reaction in these cases shows that there is an associated inflammatory change in the organ. In interpreting the result of the test in this group of cases, therefore, the results of an examination of the faeces must be considered along with it. Oxaluria is a common symptom in pancreatic disease (63 per cent. of cases), and may therefore be of confirmatory value.

**TREATMENT OF PANCREATITIS.**—*In acute pancreatitis* the abdomen should be opened and drained. Mayo Robson reports two recoveries out of four cases so dealt with. Otherwise the disease is invariably fatal.

*Chronic Pancreatitis.*—Mayo Robson emphasises the importance of preventive treatment directed to the cure of conditions which tend to favour the development of chronic pancreatitis, *e.g.* gall-stones, duodenal catarrh, duodenal ulcer, alcoholism, or syphilis. If after a fair trial of general treatment, care in diet, wet packs to the epigastrium, rest, and mild mercurial purges, the symptoms persist, and the signs of failure in pancreatic digestion are manifesting themselves, the question of surgical treatment should be seriously considered, especially when jaundice is present, because if unrelieved the condition will certainly



lead to serious degeneration of the liver and pancreas, and endanger life.

In operating for chronic pancreatitis, the surgeon must be prepared to expose the whole length of the common bile-duct, as well as the head of the pancreas. He will then be able to remove the cause, should it be a gall-stone, or a pancreatic calculus, or any other removable condition. In the absence of some obvious removable cause, it is advisable to secure efficient drainage of the infected bile and pancreatic ducts, either by cholecystotomy or cholecystenterostomy, preferably the latter. When the pancreatic disease is dependent on duodenal catarrh, associated with ulcer of the duodenum, it may be advisable, at the same time that the bile-passages are drained, to perform also a gastro-enterostomy in order to cure the original cause of the disease. Experience has taught that if the cause can be removed at an early stage an absolute cure is possible, and though complete restoration of the damaged gland in more advanced cases cannot always be promised, yet an arrest of the morbid process may be looked for, and the remaining portion of the pancreas will be able to carry on the metabolic, even if it can only incompletely carry on the digestive, functions of the gland.

*Results.*—Mayo Robson gives the following after-results of the surgical treatment of the class of case under consideration:—

“Of 102 operations undertaken in patients where chronic pancreatic trouble constituted the chief disease, or where it formed a serious complication of other diseases, 96·1 per cent. of cases were followed by recovery, giving a mortality of 3·9 per cent. Of the four cases that died, one was a cholecystotomy undertaken in a patient very deeply jaundiced, and reduced to the last stage of exhaustion before a surgical opinion was sought, and where at autopsy a cirrhotic condition of the head of the pancreas was found. The second was a cholecystenterostomy undertaken in a deeply jaundiced patient in the presence of extensive adhesions, which, on account of the feeble condition of the subject, seemed too formidable to deal with. In this case a necropsy revealed a calculus in the pancreatic portion of the common bile-duct, occluding the opening of the pancreatic duct, which would have been discovered had the patient's condition permitted a thorough exploration. A third, in a very feeble patient operated on away from home, extremely jaundiced, and suffering from repeated rigors. Drainage was imperfectly carried out, and she died of cholæmia two weeks later. And a fourth was a choledochotomy in an aged feeble man, who died of heart failure, accelerated by intestinal hæmorrhage, in the third week after operation, when the wound had healed.

“In the 55 cases of catarrhal interstitial pancreatitis, where gall-stones were found obstructing the pancreatic portion of the common duct, choledochotomy was performed in 42, cholecystotomy in 9, and cholecystenterostomy in 4.

“Of the 52 patients that recovered, 48 were living and well when last heard of; 1 is apparently well nine and a half years subsequent to operation, though sugar has recently been found in his urine; 1 died from cirrhosis of liver and ascites a year after, it being present and far advanced at the time of operation. Another has since died of acute bronchitis, and another from some non-specified ailment.

“In one case where the cause was pancreatic lithiasis, where calculi were removed both from Wirsung's and Santorini's ducts, the patient is now in very good health.



"In 46 cases of interstitial pancreatitis without gall-stones or other removable cause, the bile-ducts, and thus indirectly the pancreatic ducts, were drained in 19 cases by simple cholecystotomy, in 17 by cholecystenterostomy, and in 5 by separation of adhesions and thoroughly freeing the ducts. Of the 45 patients that recovered, no reply to letters was received from 6, who were well some time after operation. The rest were in good health when last heard of, with the exception of one (not drained) who has developed glycosuria some years after operation, but is otherwise well; one who shows signs of permanent damage to the pancreas by the ordinary test; and one who has anæmia, suggestive of the pernicious type.

"Besides the 19 cholecystotomies were 5 where the pancreatitis was associated with duodenal ulcer, and in these cases a posterior gastroenterostomy was performed at the same time, with good results in every case.

"It will thus be seen that in a very large percentage of cases the removal of the cause, together with drainage of the bile-ducts, or, in the absence of a removable cause, the simple drainage of the bile-ducts alone, is an operation that may be safely recommended in suitable cases that have failed to yield to general treatment."

LITERATURE.—*The Pancreas, its Surgery and Pathology*, by A. W. Mayo Robson and P. J. Cammidge (London), 1907, should be referred to. It is a complete treatise on the subject, and contains, besides a large number of illustrative cases, full details of diagnostic methods, and a bibliography.

**Parathyroid Glands.**—Opinions on the nature and functions of the parathyroid glands are divided between two camps. On the one hand there is a school of physiologists who look on them merely as potential or actual thyroid tissue, and on the other hand a large number of experimenters regard them as totally distinct and equally important to the animal economy. According to those who hold this view thyroidectomy produces "post-operative" myxœdema, parathyroidectomy, tetany.

Among the leading representatives of the negative school are Jolly, Swale Vincent, and Forsyth. The objections which have been directed against the results of the experimenters who assert that tetany can be caused by extirpation of the parathyroids are based on (1) the admitted technical difficulties of total parathyroidectomy, and (2) the impossibility of making certain that in the operation *all* parathyroid tissue has been removed and no aberrant parathyroid left behind, and at the same time of performing complete excision without in any way injuring the thyroid gland. (3) The contradictory nature of the alleged symptoms. Jolly and Vincent found that removal of all four parathyroids was not necessarily fatal; a few experiments which they made in the way of injuring adjacent structures in the neck without removing the parathyroids suggest that tetany might be due to accidental injury to nerves, etc., during parathyroidectomy. Forsyth reasons on evolutionary grounds, that it is impossible that the parathyroid possesses a special, vitally important, function. "If it be granted that these glands are essential to life they cannot be regarded as of recent [phylogenetic] development, yet, if their origin is to be set back to a remote evolutionary period, the difficulty has to be met that few, if any, of the organs in the body show such wide variations." Forsyth worked out the comparative histology of the glands on mammals and birds, and found that all stages between



parathyroid and typical thyroid structure were traceable. According to Forsyth, Swale Vincent, and Jolly the parathyroids and thyroids are parts of one whole; the parathyroids are "essentially thyroidal in nature, possessing no peculiar function, but engaged in the active secretion of the same substance as the thyroid gland" (Forsyth).

As opposed to this theory, we have the opinions of the large number of workers who believe they have established the existence of a definite function independent of (or even antagonistic to) that of the thyroid. In 1896 Vassale and Generali carried out an exhaustive series of experiments on the effects of extirpating some or all of the parathyroids, with or without partial or total thyroidectomy, and it is really on their results, which seemed very clearly to prove that total parathyroidectomy caused tetany, that all subsequent research has been founded. A great many other observers have obtained more or less confirmatory results; the principal experimenters have been Gley, Pineles, Welsh, Erdheim, M'Callum, and Halsted. Halsted has quite recently published a long series of experiments on dogs on transplantation of parathyroid tissue, the object of his research being to settle what course a surgeon should pursue when he accidentally injures the structures in operating for goitre. He found that grafts only "took" when an animal's own parathyroid was used (auto-transplantation), and that, only when a deficiency of parathyroid tissue had been created by the removal of at least half the parathyroids. Parathyroid tissue in excess of what the organism needs does not survive. Total thyroid-parathyroidectomy causes death from tetany; total thyroid-parathyroidectomy with auto-transplantation of a parathyroid causes myxœdema. If, in the latter case, the grafted parathyroid be removed subsequently, tetany occurs.

In addition to suffering from acute or chronic tetany parathyroidectomised animals become emaciated, lose their hair, and become affected with dermatitis. Erdheim found that in rats the enamel of the teeth showed characteristic lesions, and became defective, the process ending in loss of the upper incisors. The lower incisors grew abnormally. Albuminuria is fairly constant after the operation. In young animals there is some evidence that the growth of the bones is interfered with.

In the face of these two conflictory sets of experiments it is very difficult to form any conclusion as to the functions of the parathyroids. It may be remarked, however, that those workers who believe that extirpation of the organs cause tetany greatly outnumber those who deny a connection between the two. There is, moreover, a certain amount of evidence along other lines which lends support to the idea that ablation of the parathyroids, or disturbance of their function, causes tetany.

Tetany is a disease which occurs under a variety of different conditions, and it is now generally accepted that, whether it is associated with pregnancy, with rickets, or with occupation, it is fundamentally the same. It is not unreasonable to suppose, therefore, that insufficiency of some internal secretion predisposes to it, while some other cause precipitates an attack. Tetany has a peculiar geographical distribution; it is endemic in certain localities, unknown, or almost unknown, in others—in this respect it is comparable to goitre. Persons going to reside in a goitrous district often develop goitre; the same is observed with regard to tetany. In Vienna, where tetany used to be endemic, Chvostek states that the majority of the cases occurred among Slav immigrants. There appears to be some antagonism between goitre and



tetany, for in goitrous districts tetany is rare, and *vice versa*. In Vienna, where tetany is now declining, goitre is becoming more common. These analogies are at least interesting as suggesting that the two diseases have the same kind of origin. Another point of some interest is, that in some cases animals which have had several parathyroids removed, and have remained apparently healthy, have subsequently become pregnant and developed tetany.

In the tetany of children (see SPASMOPHILE DIATHESIS) there is some reason to suppose that calcium metabolism is at fault. MacCallum and Voightlein have shown that in parathyroidectomised animals the calcium content of the blood during an attack of tetany is lowered. The brain is poor in calcium, and the excretion of calcium by the bowel and kidneys is increased. Leopold and Reuss found that in young animals removal of the parathyroid was followed by deficiency of lime in the skeleton. MacCallum and Halsted proved that animals which appeared to be on the point of death from operative tetany could be rescued by oral, intravenous, or subcutaneous administration of calcium acetate or lactate. Some of Halsted's animals were kept alive in this way during the period which intervened between total parathyroidectomy and the grafted parathyroid beginning to function.

There is some pathological evidence of an association between lesion of the parathyroid and tetany. Facial irritability (Chvostek's sign) is one of the most constant features of the disease—it is an expression of that increased mechanical and electrical irritability of the nerves which underlies tetany ("latent tetany"). Now facial irritability according to Chvostek is not very uncommon in apical phthisis, and in one case of this kind he found tuberculous infiltration of the parathyroid. In children dying with manifest or latent tetany evidences of hæmorrhage into the glands have been demonstrated by Yanase (in Escherich's clinic) and others.

Post-operative tetany in animals, and a few cases of human tetany, have been cured by the use of parathyroid extract, either by the mouth, or subcutaneously.

THEORIES AS TO THE FUNCTION OF THE PARATHYROIDS.—As none of these has passed from the region of hypothesis to proof, it will be enough to enumerate the chief.

1. The parathyroids are simply a part of the thyroidal system, and have the same function as the thyroid.

2. The parathyroids have a "detoxicating" action; they neutralise a poison produced by the thyroid. On this theory there is an antagonism between the thyroids and parathyroids. The grounds on which this has been supposed are—(1) parathyroid extract has a beneficial action in exophthalmic goitre; (2) when the thyroid is ablated as well as the parathyroids, the resulting tetany is milder than when the thyroid is left behind; (3) when the thyroid is ablated the parathyroids undergo hypertrophy. (It would seem, however, equally plausible to believe that the hypertrophy is compensatory.)

3. The parathyroids regulate calcium metabolism. This theory may be given in the words of MacCallum and Voightlein. "The rôle of the calcium salts in connection with tetany may be conceived as follows:—The parathyroid secretion in some way controls the calcium exchange in the body. It may possibly be that in the absence of the parathyroid secretion, substances arise which can combine with calcium, abstract it from the tissues, and cause its excretion, and that the parathyroid



secretion prevents the appearance of such bodies. The mechanism of the parathyroid action is not determined, but the result—the impoverishment of the tissues with respect to calcium, and the consequent hyperexcitability of the nerve-cells, and tetany—is proven.”

LITERATURE.—The literature is rather extensive ; a full bibliography will be found in the references marked \*. \*SWALE VINCENT and JOLLY. *Journ. Phys.*, xxxii. 1904 ; xxxiv. 1906.—FORSYTH. *Journ. Anat. and Phys.*, lxii. 1908 ; *Quarterly Journ. Med.*, Jan., April, 1908.—\*MACCALLUM and VOIGTLEIN. *Journ. Exper. Med.*, 9th Jan. 1909.—HALSTED. *Ibid.*—CHVOSTEK. *Wien. klin. Wochens.*, 25th April and 3rd May 1907 ; 9th Jan. 1908, and other issues of the same journal.—YANASE. *Wien. klin. Wochens.*, 26th Sept. 1907.—LEOPOLD and REUSS. *Wien. klin. Wochens.*, 28th Aug. 1908.—ERDHEIM. *Mittheil. a. d. Grenzgebiete Med. u. Chir.*, No. 16, 1906.—VASSALE and GENERALI. *Arch. ital. di Biol.*, 1895, 1896.—\*RUDINGER. *Ergeb. d. inner. Med. u. Kinderheilk.*, Bd. ii. (Berlin), 1908 (critical review).

**Pelvis, Hæmatocele and Hæmatoma of.**—There is little to be added to the account given of pelvic hæmatocele and hæmatoma in the *Encyclopædia Medica*, Vol. IX. p. 267. There have indeed been marked advances in our knowledge of hæmorrhage into the pelvic tissues, but these have been made in connection with ectopic pregnancy and are considered under that heading (*vide* p. 170). There is an increasingly strong tendency to suspect extra-uterine pregnancy in nearly all cases of hæmatocele, a tendency which has been greatly favoured by the discovery of cases of primary ovarian gestation and of early abdominal pregnancy (primary or secondary), and by the knowledge that the Fallopian tubes after tubal abortion, and even after tubal rupture, return very quickly to a normal state. Unless the tissues involved in a hæmatocele be carefully examined under the microscope and found free from foetal elements, it must be very difficult entirely to exclude an ectopic gestation. At the same time it cannot yet be confidently affirmed that pelvic hæmatoceles are always the result of tubal or ovarian pregnancies. Otto Engström (*Arch. f. Gynaek.*, lxxxii. p. 60, 1907), for instance, has described a case of intra-peritoneal hæmatocele due to hæmorrhage into a corpus luteum ; the tubes were normal, and a microscopic examination showed no foetal elements ; and in de Rouville's case (*Ann. de gynéc. et d'obstét.*, 2 S. v. p. 222, 1908) the hæmorrhage seems to have been caused by the rupture of follicular cysts in the ovary, but the writer gives no details regarding the menstrual history of the patient, and it can hardly be affirmed that ovarian pregnancy was excluded. But, apart from tubal and ovarian conditions, there is the possibility of hæmorrhage into the pelvic peritoneum or cellular tissue from other causes ; in Perrier's observation (*Thèse de Lyon*, 1904), for instance, there were uterine fibromyomata, and hæmorrhage was traced to subserous uterine varicose veins of the uterus, and in Walter's case (*Journ. Obstet. and Gynec. Brit. Emp.*, xiii. p. 145, 1908), there was bleeding into both broad ligaments after the performance of a supra-vaginal hysterectomy. But these are exceptional occurrences. So commonly is hæmatocele the result of ectopic gestation that unless there is very strong evidence to the contrary it should, when diagnosed, be regarded as so originating, and it should be treated in the same way as an extra-uterine pregnancy, viz. by opening the abdomen, securing the bleeding points, and clearing out the blood and clot.



**Pemphigus and Dermatitis Herpetiformis.**—

Whilst many still hold that pemphigus and dermatitis herpetiformis are diseases of nervous origin, there has been a good deal of evidence recently brought forward that they are due to toxæmias, which are probably of intestinal origin. Johnstone and Engmann are strong upholders of this opinion. In support of this view is the fact, which is undoubted, that nearly all of such cases show a marked indicanuria. Treatment based on an attempt to wash out any toxic substance from the system has given favourable results. Johnstone recommends giving large quantities of water to drink, at least three quarts daily in addition to the liquid which is taken at meals. He also gives diuretics, and helps elimination through the skin by hot-air baths and pilocarpine, gr.  $\frac{1}{40}$ – $\frac{1}{20}$  by mouth four times daily. Iron should also be given if there is any anæmia.

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**Plague.**—In a paper entitled “Recent Researches into the Etiology of Plague in India,” Col. Bannerman, the Director of the Bombay Bacteriological Laboratory, summarises the conclusions to which these lead in the following words:—1. Pneumonic plague is highly contagious, but being rare (less than 3 per cent. of all cases) plays a very small part in the spread of the disease. 2. Bubonic plague in man is not infectious, and is entirely dependent on the disease in the rat. 3. The infection is conveyed from rat to rat, and from rat to man, solely by means of the rat-flea. 4. Plague is usually conveyed from place to place by rat-fleas brought by people in their baggage or on their persons.

The present epidemic of plague in India dates from the autumn of 1896; in China it had broken out two years previously. One of the features of the Indian epidemic which soon became apparent, was that in each locality it had a particular seasonal prevalence of its own: thus in Bombay, the epidemic occurs in the early months of the year; in Poona, only 80 miles away, the disease does not appear till the autumn. As epidemic succeeded epidemic facts came to light which pointed to the existence of infected houses—such houses were most infective by night; they might become infective even where standing empty; houses in close proximity became infective, although caste prejudices ensured that the inhabitants had no inter-communication. These and other facts suggest the idea of spread by animals, and the only animal that fills the rôle is the house rat of India. Notwithstanding the adverse criticism passed by the first Plague Commission on Simond’s suggestion that the flea might communicate the disease from rat to rat and from rat to man, Liston reinvestigated the subject, and placed the theory on an assured basis.

Two species of rats are common in Bombay—*mus rattus*, the black rat, and *mus decumanus*, the brown Norway rat. The former is the house rat proper; the latter lives apart from the people in gullies and sewers. They meet in the basements of houses. *Mus decumanus* develops plague before *mus rattus*, but man is more likely to become infected by *mus rattus*, with which he is brought into more intimate contact. The fleas of rats (*pulex cheopis*) are of a different species from those of man, but in the absence of rats this flea will take to other animals and even to man. In the stomachs of these fleas, taken from



plague-infected houses, living plague germs are found. When rats die of plague the infected fleas leave them and begin to attack other animals—*e.g.* guinea-pigs—and transmit the disease to them; they also bite man, and infect him.

Bannerman considers that there is no evidence that rats spread plague by infecting food with their excreta, nor by contaminating the soil, suppositions which have both been entertained to account for the spread of the disease.

Col. Lamb, of the Second Plague Commission, writes, concerning the experimental transmissions of plague from rats to rats, monkeys, etc.:—“(a) Close and continuous contact of plague-infected animals with healthy animals, if fleas be excluded, does not give rise to an epizootic among the healthy animals. As the godowns [experimental huts] were never cleaned out, close contact includes contact with *fæces* and urine of infected animals. Close contact, even the suckling of young by plague-infected mothers, does not give rise to the disease. (b) Where fleas are present the epizootic, if it does start, varies in severity and rate of progress according to the season of the year and the number of fleas present. The season in which epizootics are readily produced experimentally, and spread rapidly, corresponds with that of the plague epidemic. (c) An epizootic of plague can occur in a godown containing infected fleas without direct contact of healthy animals and infected animals. (d) In an infected godown the infection is effective in proportion as the test animals are accessible to fleas. (e) Infection can take place without any contact with contaminated soil. (f) Aerial infection is excluded. (g) The experiments lead to the conclusion that fleas, and fleas alone, were the transmitting agents of infection.” Turning next from experimentally infected godowns, to experiments made by placing susceptible animals in naturally infected native houses, we find—“(1) Guinea-pigs may contract plague if allowed to run loose in plague-infected houses; and many rat-fleas are found upon them. (2) In houses where all plague germs are killed by disinfectants, guinea-pigs still are in the same proportion, and an equal number of rat-fleas is found on them. (3) Fleas caught on rats dead of plague are capable of infecting healthy rats or guinea-pigs not otherwise exposed to infection. (4) Fleas from guinea-pigs which have been allowed to run loose in infected rooms are similarly infective to healthy rats or guinea-pigs not otherwise exposed to infection. (5) Guinea-pigs in cages which protect them from the floor or other source of infection, but which are exposed to the attacks of fleas in plague-infected rooms, contract plague in a certain proportion of cases. Those similarly placed but protected from fleas do not develop the disease. (6) Most of the fleas caught in the above manner are rat-fleas, and have plague bacilli in their stomachs in 19·7 per cent. of those dissected. (7) Almost all the primary buboes in animals thus infected are in the neck, and the commonest place for fleas to be found is also in the fur round the neck. (8) Plague-infected houses have twelve times the number of fleas in them that those free from suspicion of infection have” (Bannerman). In considering how man becomes infected it is important to remember that the avenue through which the germs gain entry is the skin, at least in the ordinary bubonic and septicæmic type of the disease. Pneumonic plague may be ignored, as it occurs in only about 2·5 per cent. of all cases. In man there is no seat of election for buboes; the primary



bubo develops in connection with the area of skin attacked. There is a definite time relationship between the *rattus* epizootic and the human epidemic. First comes the epidemic among the brown rats, then the epidemic among the black rats, last the epidemic among men. When the epidemics are at their height the intervals between the maximum death-rate in rats, and the maximum death-rate in man is about 10-14 days. Lamb explains this interval thus: There is first a period corresponding to that between the disappearance of the rat and the time when the flea, pressed by hunger, will attack man. This has been experimentally proved to be about three days. After the fourth day fleas rapidly become less infectious. Second, there is a period corresponding to the incubation of plague—three days. Third, there is the period corresponding to the average duration of plague—five to six days. Adding these together we get a period of eleven to twelve days, corresponding to the interval between epizootic and epidemic.

Travellers are the chief agents in distributing plague. Fleas fed on man may remain alive for three weeks, and may remain infective for 15 days. There is thus ample time for their conveyance from place to place. In the new district the fleas escape to the abundant rats, infect them, and thus start an epidemic. Clothes containing fleas may, of course, transmit infection in the same way. Carriers of infected fleas may themselves escape infection.

The plague germ undergoes no transformation in the flea; they are excreted in the fæces on the skin of the host, and invade the wound made by the flea's pricker. They are not excreted by the saliva or mouth of the flea. The common cat and dog flea (*P. felis*) cannot transmit the disease, but both *ceratophyllus fasciatus*, the common rat-flea of Northern Europe, and *P. irritans*, the human species, can do so, the former with ease, the latter with difficulty.

The above is abridged from Col. Bannerman's paper (*Edin. Med. Journ.*, May 1908), which gives the literature of the subject.

**Poliomyelitis anterior acuta.**—Owing to the epidemic prevalence of anterior poliomyelitis in certain countries in recent years, the infectious nature of the disease must now be regarded as certain. Both the Swedish and New York epidemics have afforded opportunity for much work on the pathology and clinical features of the disease, but the infective agent has not yet been discovered. Holt and Bartlett have collected records of 35 epidemics, the chief being those which occurred in Norway and Sweden in 1905-1906. There was also an epidemic in Australia in 1904 (108 cases), and in Vermont (132 cases), but nowhere has the disease been so widespread as in the Scandinavian peninsula, where over a thousand cases occurred during 1905 and 1906. The influence of season is very definite; most cases occur in July, August, and September, or in the corresponding months in the southern hemisphere. There is no evidence that epidemics are followed in ensuing years by an increased number of sporadic cases, as occurs in cerebro-spinal meningitis. Epidemics cover a wide extent of country, and the incidence of the disease is little influenced by locality and surroundings. The mortality is somewhat high—12 per cent. "The discrepancy between these figures and the opinions drawn from a study of the sporadic form of the disease is, we believe, explained by the fact that cases with bulbar symptoms, which make up most of the



fatal cases in epidemics, have not been recognised as poliomyelitis when they occur in scattered instances" (Holt and Bartlett). Most patients are under four, but during epidemics a large number of older children and adults are attacked than at other times. Wickmann states that in the Norwegian epidemic the incubation period was in most cases one to four days. The disease spread by direct contact and through the intermediary of healthy persons. It spread along lines of communication (roads and railways); it tended to occur in foci, beginning with one or two isolated cases, and to linger on in a district in which it had once taken hold. Holt and Bartlett are more guarded as to the communicability of the disease; they regard it as an open question, and think that it can only be communicable "to a very slight degree."

**MORBID ANATOMY.**—The chief point is that the lesions of anterior poliomyelitis must no longer be considered as limited to the anterior horns of grey matter, but are widely spread throughout the central nervous system—cord, medulla, and brain. The primary lesion is in the pia mater, and even in mild cases there is a generalised inflammation of the cord, brain, and cerebral and spinal meninges. There is a diffuse infiltrative myelitis chiefly of the grey and also of the white matter; the cellular infiltration spreads along the vessels. The cortex and cranial nerve nuclei may be involved. The process is not embolic. Bacteria have not been demonstrated. Wollstein could find no evidence of antigens or antibodies in the cerebro-spinal fluid.

**CLINICAL FEATURES.**—These have been carefully studied by Medin of Stockholm. The disease, indeed, is now called by some authors "Heine-Medin's disease," in recognition of Heine, who first described the classical type in 1840, and Medin, who has elaborated the clinical picture by including the atypical cases which occur in seasons of epidemic. Medin adopts the following classification of cases:—(1) Spinal form. (2) Ascending or descending paralysis (Landry's paralysis). (3) Bulbar or pontine form. (4) Cerebral form. (5) Ataxic form. (6) Polyneuritis. (7) Meningeal form.

Emphasis is laid on the occurrence of initial symptoms pointing to widespread early implication of the meninges—fever, headache, stiffness of the back, and tenderness over the spine.

1. *Spinal Form.*—The symptoms of this, the classical type of the disease, are so well known as to need no description except in one particular. Wickmann points out, as has also been done by Ibrahim, that paralysis of the abdominal muscles is not very uncommon. Either the whole abdomen, or merely one segment of it, may be paralysed. The paralysis shows itself by a marked ballooning of the affected area when the patient cries or strains. If the paralysis is localised and permanent it leads to a hernia. Previous to 1905 Oppenheim had stated that there was no evidence of segmental innervation of the abdominal muscles. He thought that a lesion between the eighth and eleventh dorsal segments would paralyse the musculature of the whole of one side of the abdomen, and described an "abdominal symptom-complex" characterised by unilateral diminution of the abdominal reflexes, deviation of the umbilicus to the healthy side, and bulging of the paralysed half of the abdomen. Ibrahim and others, however, have recorded cases of localised paralysis and wasting of the abdominal muscles from anterior poliomyelitis, thereby proving that a segmental innervation exists.

2. *Landry Type.*—These are very often fatal—45 out of 159



deaths were due to ascending or descending paralysis in Wickmann's series of cases. "Landry's paralysis" in the adult is, according to Medin, the same as "ascending anterior poliomyelitis" in the child.

3. *Bulbar or Pontine Form.*—The nerves most frequently involved are the facial and hypoglossal; the muscles of the eyes, of the throat, or of the larynx may be paralysed. Any of the medullary centres may be affected.

4. *Encephalic Form.*—This is rare; it corresponds with Strümpell's polio-encephalitis.

5. *Ataxic Form.*—In this an ataxic gait and paresis of groups of muscles are the chief symptoms. The reflexes are often increased. The lesion is uncertain.

6. *Polyneuritis.*—The cases which are suggestive of this type are—(1) Such as recover rapidly and completely; (2) those with evidence of lesion of a single nerve; (3) acute ataxias.

7. *Meningeal Forms.*—These must obviously resemble cerebrospinal meningitis somewhat closely. The following table of distinctions is abridged from one drawn up by Wickmann:—

*Heine-Medin's Disease.*

1. Residual paralysis is usually of limbs; permanent.
2. Fever of short duration.
3. Herpes rare.
4. Rashes absent.
5. No sequelæ.
6. No hydrocephalic stage.
7. Puncture fluid clear.
8. Meningococci absent.
9. Lymphocyte infiltration of pia.

*Epidemic Meningitis.*

- Usually of eye muscles; transitory.
- Prolonged.
- Common.
- Frequent.
- Deafness common.
- Hydrocephalus common.
- Usually turbid.
- Present.
- Leucocyte infiltration.

8. *Abortive forms* characterised by fever, headache, and stiffness of the neck can only be diagnosed, even with probability, during the prevalence of epidemics.

*Prognosis.*—The most important points in prognosis as to life are—(1) The Landry and bulbar types are often fatal. (2) The general mortality (12·1 per cent.) is fairly high. (3) The mortality rate increases with the age of the patient. Up to 11, it is about 10 per cent.; from 12 to 14, 28 per cent.; from 27 to 29, 33 per cent. (Wickmann's statistics). (4) Most deaths occur on the fourth day.

As opposed to Medin's extension of the term poliomyelitis anterior acuta to cover the above wide range of atypical cases, Berg, basing his opinion on the New York epidemic of 1907, asserts that sporadic anterior poliomyelitis is radically different from the epidemic disease. He points to the difference in the morbid anatomy, in the symptomatology, in the age of the patient, in the mortality, in the presence of infection in one case, and its absence in the other, as justification for distinguishing clearly between sporadic anterior poliomyelitis and epidemic meningo-myelo-encephalitis.

LITERATURE.—HOLT and BARTLETT. *Amer. Journ. Med. Sci.*, May 1908.—WICKMANN. *Zur Kenntniss d. Heine-Medinschen Krankheit* (Berlin), 1907.—WOLLSTEIN. *Journ. Exper. Med.*, July 1908.—IBRAHIM. *Deutsche Zeitsch. f. Nervenheilk.*, Bd. xxix. p. 113, 1905.—OPPENHEIM. *Ibid.*, Bd. xxiv. p. 325, 1903.—BERG. *Med. Rec.* (New York), 4th Jan. 1908.

**Polycythæmia Vera.**—This is only one of the names given to a rare disease of middle life, which is characterised by splenic



enlargement and a persistent excess of the red corpuscles of the blood. The symptom-group was first described by Vaquez in 1892; important additions have been made to our knowledge of the disease by Osler, Türk, Parkes Weber, and others. In France it is sometimes known as Vaquez's disease; in America and elsewhere as Osler's disease; it has also been called "chronic polycythæmia with cyanosis," "splenomegalic polycythæmia," and "myelogenous polycythæmia." Türk suggests the name "erythræmia," and for several reasons this seems the best proposed; it brings out the analogy to leukæmia (for polycythæmia vera is probably a primary disease of the marrow), and the contrast with "erythrocytosis," a term which may be applied to any secondary increase in the red corpuscles, comparable to leucocytosis.

CLINICAL FEATURES.—The disease is not hereditary; the sexes are about equally liable; the disease usually occurs between the thirtieth and fiftieth years. A relative large number of the patients have been Jewish, but the evidence of racial proclivity is slender. The characteristic features may be discussed under the heads of (1) plethora, (2) splenomegaly, (3) blood changes, (4) general symptoms.

(1) *Plethora*.—Cases of polycythæmia vera always present a plethoric appearance. The face is deeply congested or cyanosed. In some cases cyanosis, in others unnatural floridness, predominates. The engorgement or cyanosis is most conspicuous in the face, ears, and extremities; it seldom affects the general surface of the body. A similar condition of the mucous membrane of the mouth, tongue, and conjunctivæ is present; the retina shows the same change. The degree of congestion varies from time to time in the same person; cold increases the cyanosis, warmth tends to make the face more ruddy. Under the influence of emotion cyanosis may give place to flushing.

(2) *Splenomegaly*.—Some degree of splenic tumour can generally be made out. The organ may only reach a few finger-breadths below the ribs, or it may extend down to the umbilicus. On the whole, the enlargement is moderate, and the enormous hypertrophy met with in some cases of leukæmia does not occur. The spleen may vary in size from time to time, and complete subsidence of the enlargement has been observed. The organ is small and firm. There is moderate increase in the size of the liver in most cases; excessive enlargement is rare.

(3) *Blood Changes*.—The red corpuscles and hæmoglobin are always, the leucocytes usually, increased. The specific gravity, and, what is of more practical importance, the viscosity, of the blood are high. The red corpuscles generally number from 7,000,000 to 9,000,000 per c.mm., though counts of 13,000,000 have been recorded. Mackey gives 8,900,000 as the average. As a rule the cells show few changes otherwise; poikilocytosis, polychromasia, or the presence of a few normoblasts are mentioned by some authors. The hæmoglobin is raised, but not proportionately the red corpuscles; the colour index, therefore, is below 1·0. Moderate leucocytosis is the rule; Mackey found that the average in 40 cases was 14,250. The percentage of polynuclears is high—70 per cent. or so. A few myelocytes may be present. Blumenthal has recorded a case in which 36 per cent. of myelocytes were found, but the case was an exceptional one in other respects as well.

(4) *Other Symptoms*.—Subjective symptoms vary considerably, and may be absent. Headache, vertigo (suggestive of Menière's disease), fulness in the head, paroxysmal dyspnœa, abdominal pain, dyspepsia, thirst, and constipation are all common. Hæmorrhage from the gums,



nose, uterus, and other mucous membranes occur. The arterial pressure is often high (180 mm. Hg); there is sometimes cardiac hypertrophy. Distension of the superficial veins is common. Albuminuria is present in the majority of patients. As among the more frequent complications, jaundice, cirrhosis of the liver, erythromelalgia, and arterio-sclerosis may be mentioned.

**MORBID ANATOMY.**—The only constant lesion, apparently, is the evidence in the marrow of excessive erythropoiesis. This will again be referred to. Infarcts of the enlarged spleen, obvious distension of the abdominal veins, and thromboses are also characteristic. In not a few cases cirrhosis of the liver, portal obstruction, or tuberculosis of the spleen has been found, and, of course, many other complicating lesions—*e.g.* cerebral hæmorrhage. The relationships of these pathological changes will become more apparent as the pathology of the disease is considered.

**PATHOLOGY.**—Polycythæmia, using the word in a general sense to imply an increase of the red corpuscles in the blood, may be either relative or absolute. *Relative polycythæmia* results from concentration of the blood by loss of fluid from the body, and with it we have nothing further to do. *Absolute polycythæmia*, however, occurs either as a primary or a secondary condition. As secondary polycythæmia, we reckon the polycythæmia of high altitudes, and the polycythæmia of stasis. It is well known that in many cases of chronic cyanosis, whether from congenital heart disease, acquired heart disease, emphysema of the lungs, or, in fact, any condition leading to interference with the oxygenation of the blood, the red corpuscles may rise and remain very much above the normal figure. At high altitudes the same occurs, and in both the explanation usually accepted is that the hyperglobulia is a compensatory response of the organism to lack of oxygen. In secondary polycythæmia of this description there is evidence, after death, of increased erythropoietic activity of the marrow.

As other possible causes of secondary polycythæmia Weber enumerates the following:—1. Stasis due to portal obstruction. 2. Toxic conditions, such as phosphorus poisoning, and chronic intoxication with coal tar derivatives—antipyrin, etc. 3. Chronic infectious diseases—tuberculosis, syphilis, malaria. 4. Ill-defined conditions—suprarenal lesions, affections of the marrow (*e.g.* in osteitis deformans), arterio-sclerosis of the vessels of the limbs.

In erythræmia proper there is always evidence of increased formation of red cells by the marrow—this is the sole constant anomaly found. It may thus be regarded as analogous to leukæmia, in which there is increased leucoblastic activity. It is, however, remarkable that in cases of polycythæmia vera there is increase in the leucoblastic, as well as the erythroblastic tissue of the marrow. In Blumenthal's case, referred to above as exceptional, the marrow is described as bearing a superficial resemblance to foetal marrow, but the principal change was a leucoblastic degeneration. The marrow lesion being the only constant change, we are able to put on one side Vaquez's view that the disease was due to tuberculosis of the spleen, and to rule out chronic visceral lesions as causes of stasis, at least in the majority of cases, though it is admitted that occasionally portal obstruction gives rise to a very similar symptom-complex, in which splenomegaly and polycythæmia are the prominent features. It is less easy to eliminate the possibility of a chronic toxæmia, but there is at least no evidence of any single special source of toxic mischief in these cases.



But it must be remembered that in addition to the marrow lesion the patients all exhibit very marked signs of stasis and impeded circulation, and the question arises, is this the cause, or is it an effect, of the erythræmia? Saundby believes that the stasis, impaired peripheral circulation, and generalised "asphyxia" of the skin are sufficient to cause a compensatory reaction of the marrow. The condition is "a cerebro-spinal neurasthenia, causing vasomotor spasm, with engorgement of the capillary and venous circulation and congestion of the internal organs, especially of the liver and spleen, with muscular weakness, loss of knee-jerks, and mental impairment, shown by loss of memory, apathy, and drowsiness." Mackey regards the splenic enlargement as in some cases primary, and suggests that "owing to the stasis and imperfect oxygenation of an enormous quantity of blood in the enlarged spleen, the same compensatory forces are set in motion as in the case of congenital and other forms of heart disease, and probably by stimulating the bone marrow produce the polycythæmia.

According to the view of Weber (which is also that generally held) the erythræmia is the cause of stasis. "The increased blood viscosity necessarily accompanying polycythæmia must, however, favour the development of a secondary condition of blood stasis, whether there be a compensatory increase in blood pressure (as there usually is in erythræmia) or not. Delayed circulation in its turn favours the occurrence of thrombosis in the various viscera, and the occurrence of thrombosis further hampers the circulation. Again, delayed circulation, and congestion, in the blood-vessels of the lungs and branches promote the development of chronic catarrhal changes, which induce cyanosis and throw extra work on the right side of the heart. So that in erythræmia an elaborate vicious circle is established; the polycythæmia in various ways tends to impede the circulation, and the blood stasis thus produced favours cyanosis and increases the circulatory difficulty by giving rise to a further (compensatory secondary) polycythæmia in addition to the primary (myelopathic) polycythæmia. Thus the connection and sequence of the main symptoms is:—(1) Increased marrow erythropoiesis; (2) excessive viscosity of the blood; (3) dilatation of the small vessels to lessen resistance to abnormally viscous blood; (4) plethora compensatory for increased viscosity; (5) arterial hypertonus from the strain on the circulation; (6) cyanosis due to inadequacy of compensatory changes which precede.

There is no evidence that polycythæmia can be caused by increased resistance and longer life of the red corpuscles.

Another theory, held by Lommell, is that the polycythæmia is compensatory to low oxygen capacity of the hæmoglobin. Lommell estimated the power of the hæmoglobin to fix oxygen, and found that the oxygen quotient was  $\cdot 903$ , as compared with  $1\cdot 24$  in a normal control. Herringham suggests that there may be some fault in the cytoplasm, or in the hæmoglobin of the red cells, which prevents them from being good oxygen carriers, or that there is some abnormal reducing agent in the blood which reduces oxyhæmoglobin but does not turn it into methæmoglobin or sulphohæmoglobin. The want of oxygen might stimulate the bone marrow to form fresh cells, as it does where high altitudes or heart disease is the cause.

On the whole, taking the four principal hypotheses as, (1) primary overproduction of red corpuscles; (2) stasis; (3) increased longevity of red corpuscles; and (4) deficient oxygen-carrying power, the balance



of evidence seems to incline towards the first being the true explanation of the disease.

In erythrocytosis, from whatever cause, the blood is always abnormally viscous; it flows through the capillaries with difficulty, and thus cyanosis readily occurs. The total volume of the blood in erythræmia, estimated by Haldane and Lorrain Smith's carbon-monoxide method, is above normal (Weber, Haldane, Boycott). This fact is associated with the distension of the abdominal veins which is so marked a feature at post-mortem examination. In some cases the arterial blood-pressure is high (erythræmia hypertonica), with cardiac hypertrophy; in others it is low. Enlargement of the spleen is occasionally absent.

**DIAGNOSIS.**—From what has been said it will be seen that although in its main outlines the symptom-group is sufficiently well defined, difficulties in diagnosis will often arise. (1) In the first place the possibility of portal obstruction or organic intra-thoracic disease—*e.g.* adherent pericardium, fibroid phthisis, or emphysema—must be considered. The history of an illness capable of causing enlargement of the spleen will render the diagnosis uncertain. Weber states that in polycythæmia an enlargement of the liver without much enlargement of the spleen is in favour of polycythæmia secondary to stasis. (2) In some cases chronic polycythæmia is apparently due to primary tuberculosis of the spleen. (3) In any obscure case of cyanosis the possibility of chronic poisoning with coal tar products (acetanilide, etc.) should be investigated.

**COURSE, DURATION, AND TREATMENT.**—Mackey states that the average duration of the disease from the time of the appearance of the first symptom to the date when the patient came under observation or died is four years. Remissions may occur.

Treatment is unsatisfactory. The diet should probably be as free from iron as possible; "sour milk," or some preparation of lactic acid bacilli, might be used to influence the intestinal flora. Arsenic, quinine, thyroid, and vasodilators have proved of no use. Inunction with unguentum hydrargyri iodidi is said to have benefited one case. Splenectomy is useless, and often fatal. The X-rays generally fail; in one or two cases they seem to have done good. Inhalations of oxygen have been tried fruitlessly. Venisection sometimes relieves the symptoms for the time being. Drugs which are likely to produce cyanosis (acetanilide, etc.) should be avoided.

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## Pregnancy, Management of.

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DURING the past few years increased attention has been paid to the physiology and pathology of pregnancy, and the medical profession is



beginning to regard pregnancy as a period during which supervision is required if the health of the mother and her unborn infant is to be secured. The days have passed when in better-class practice the medical attendant was satisfied that he had done all his duty to his pregnant patient if he went at once to attend her at her confinement when sent for. Now it is beginning to be realised that the obstetrician's services may be of value in pregnancy, and that it may be well for the patient to have the advice of her doctor upon even the minor ailments of gestation, for, indeed, out of them may grow such major disasters as eclampsia and hyperemesis.

Articles dealing with the management of pregnancy from the pens of Professors Davis, G. M. Boyd, and Cooke Hirst, and Dr. Richard C. Norris (*Therap. Gaz.*, xxxi. pp. 74-86, 1907), all emphasise the importance of the medical supervision of pregnant patients. The vaginal examination in early pregnancy is of value in enabling the attendant to diagnose and correct displacements of the uterus (retroversion and ante flexion), to estimate pelvic contractions and deformities, and to detect the presence of tumours, *e.g.* ovarian dermoids. Letters in the *British Medical Journal* (ii. for 1905, pp. 681, 833, 906) record cases in which fibroid tumours of the uterus and ovarian cysts had proved formidable complications of labour; the writers point out that early vaginal examinations in pregnancy would have led to their discovery and treatment under more favourable circumstances. Even as late as the seventh month vaginal palpation may reveal a degree of pelvic contraction which may be safely overcome then (by induction of labour), but which, if met with at full term, may necessitate Cæsarean section or pubiotomy.

The diet of the pregnant woman requires supervision, for we now know that it is of great importance in the cases in which there is the risk of renal inadequacy and albuminuria. Further, Prochownik and his followers (*Therap. Monatsh.*, Hefte 8 and 9, 1901) have collected clinical evidence which sufficiently shows that the food of the mother influences the size and condition of the unborn infant; and experimental results are being accumulated in support of his contention (*vide* article in *Brit. Med. Journ.*, ii. for 1901, pp. 1187 and 1368; Lochhead's papers in the *Trans. Edin. Obstet. Soc.*, xxxiii. pp. 120, 267, 1907-8; etc.).

In albuminuria a strictly milk diet is essential until the albumen has disappeared or is very small in quantity, and thereafter a modified dietary may require to be continued till the birth of the child. "While milk, fruit, and bread form an ideal diet for the pregnant woman, very few will accept it," is the opinion of an American obstetrician. The food of the patient also is of great importance in cases of hyperemesis gravidarum, where rectal feeding may have to be long continued. "The use of water as a beverage is most important during pregnancy; few patients who suffer from nausea in the early months are not benefited by the use of vichy, apollinaris, soda, or any other slightly aerated and pure water." There is danger in the commonly given advice that the pregnant woman must eat "enough for two," the second person being her unborn infant; Bar's researches (*vide* PREGNANCY, PHYSIOLOGY OF) go to show that the additional nourishment necessary for the foetus is obtained by a better assimilation of material in the mother's intestine, and by a smaller excretion of the same. Most women probably eat quite enough for their unborn infants as well as themselves, and are not



called upon to make any marked change in the quantity of the food taken, although its nature may require revision. Dietetic indiscretions are much more dangerous in a time of strain, such as pregnancy, than in the non-pregnant state.

Urinanalysis is, of course, of immense importance in pregnancy, and especially in first pregnancies where the capabilities of the kidneys to do more work without suffering injury are unknown factors. Further, in doubtful cases, the simple testing for albumen is not sufficient; its quantity must be estimated, as must also that of the urea, and perhaps of the chlorides. The modern obstetrician can hardly regard his duties to his pregnant patient as faithfully carried out unless he makes careful analyses of her urine at regular intervals.

Further, the patient should be instructed to come to her doctor for advice when her pregnancy is complicated in any way. She should be told to report such deviations from the normal as headache (especially persistent headache), marked diminution in the amount of urine passed, eye symptoms, troublesome constipation, puffiness below the eyes, swelling and tenderness of the veins of the legs, etc. A great field of usefulness is lying ready for the enterprising obstetrician to enter on, if only women could be got to understand that medical attention may be very helpful in overcoming the minor ailments of pregnancy and in preventing the major disasters. "Women should be taught to seek their doctors early in pregnancy," writes an American authority, "after the second missed period an office consultation should be arranged for." This may be difficult of accomplishment, for, in the past, the medical man has left his pregnant patients very much to themselves, or has thrown them for advice upon their nurses; he has now to demonstrate that his attentions are both needed and helpful. Most women still are under the impression that they are doing the best for themselves if they send for their medical attendant when the pains of labour supervene.

A great impetus has been given to the understanding and management of morbid pregnancies by the institution of hospital treatment for the same. A full review of the movement for the establishment of pre-maternity hospitals will be found in Ballantyne's Valedictory Address to the Edinburgh Obstetrical Society in 1907 (*Trans. Edin. Obstet. Soc.*, xxxiii. pp. 24-60), and an account of thirty cases of morbid pregnancy treated in the pre-maternity ward of the Edinburgh Royal Maternity Hospital during 1908 was published early in the present year (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. pp. 93 and 169, 1909). The following suggestions have been made for pre-maternity beds, wards, and hospitals. First, with regard to beds in maternity hospitals: the pre-maternity bed or beds should be strictly reserved for the reception of cases of morbid pregnancy; if a patient suffering from one of the maladies of pregnancy pass into labour within forty-eight hours of her reception into the pre-maternity bed she shall not be regarded as a pre-maternity case, for, obviously, such a brief stay does not permit of any satisfactory attempt towards the effective treatment of her malady; the pre-maternity beds should be placed in a ward by themselves, and should not be located in the ordinary ward used for the puerperal patients; a sister should be in charge of these beds who has a surgical and medical as well as an obstetric experience, for the nursing required will in most instances be more strictly medical or surgical than obstetrical; no attempt should be made to adapt the diet of puerperal patients for the use of the pre-maternity patients, for, as



a rule, the latter require quite different food; special case-taking forms should be used for the pre-maternity cases; a special case-book should be kept in which every patient who has been in the pre-maternity bed for the period of more than forty-eight hours, for such cases, if successfully treated, will sometimes not remain in the hospital for delivery, *e.g.* retroversion of the gravid uterus at the third month; in pre-maternity cases special attention should be paid to urine analysis, to examination of the blood and of the blood pressure, to that of the nervous system, to ophthalmoscopic investigations, to a detailed and thorough examination of the signs and symptoms of pregnancy, including estimations and descriptions of the foetal heart and of the foetal movements. Then, with regard to pre-maternity wards or hospitals: the ward or hospital should be connected with the maternity hospital, but should not be included in it; the pre-maternity portion should resemble more closely an ordinary general hospital in its construction and arrangement than a maternity hospital; the management of the pre-maternity should be kept as far as possible distinct from that of the maternity, the nursing, diet, regimen, and to some extent the medical treatment required being different; there should be a resident physician whose business it would be to take charge of the pre-maternity hospital, whilst the physician of the maternity hospital would make a daily visit; and the supervision of labour would always be the signal for the transference of a patient from the pre-maternity to the maternity hospital, her record would go with her, and would serve as a guide for diagnosis and treatment in the other part of the building. Suitable cases for treatment in pre-maternity beds, wards, or hospitals are pregnant patients suffering from albuminuria, heart disease, intractable vomiting, pulmonary disease, hepatic disease, anæmia and other blood disorders, and various nervous maladies (especially epilepsy, chorea gravidarum, hystero-epilepsy, hysteria, and paralysis), diseases of the reproductive organs (such as retroversion of the gravid uterus, threatened abortion, pruritus and œdema vulvæ, uterine prolapse, cystocele, vulvar inflammation and abscess, uterine myomata, and suspected ectopic gestation), and hydramnios and other conditions leading to over-distension of the uterus; and cases of suspected hydatid mole, of placental hæmorrhage, missed labour, or of antenatal death or deformity might with advantage be kept under observation. Further, patients who had suffered in past pregnancies from habitual abortion, "habitual" foetal death or disease, habitual prematurity or post-maturity, or from eclampsia, might be dieted, kept at rest, or treated with medicinal means, etc., in future pregnancies in order, if possible, to prevent the recurrence of these reproductive disasters. Patients who have already had one or more eclamptic seizures are not so suitable for pre-maternity treatment; but even in them labour does not always supervene immediately, and purely medical treatment for a few days may be possible and may serve to save the mother's if not also the child's life (*vide Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 98, 1909). Cases which are unsuitable for treatment in a pre-maternity bed or ward would seem to be infectious fevers occurring as complications of pregnancy and cases of insanity; cases of syphilis, gonorrhœa, and gonorrhœal vaginitis and vulvitis might be dealt with if care were used to avoid infection; alcoholism and dipsomania, in the absence of delirium tremens, might also be admitted, but they would necessitate more watching and nursing than could be easily given.



**Pregnancy, Physiology of.**—Since the beginning of the twentieth century many contributions have been made to our knowledge of the physiology of pregnancy, but it cannot yet be said that we have enough information regarding the inter-relation of the lives of mother and unborn infant to enable us to understand the maladies peculiar to pregnancy and to take adequate means for their prevention or cure. This is true in a very special way of eclampsia (*vide* ECLAMPSIA), and applies also to hyperemesis gravidarum, to jaundice in pregnancy, and to chorea of the pregnant woman. For this reason there is no uniformity of belief regarding such means of treatment as the emptying of the uterus in the diseases which have been named, as well as in pregnancies complicated by heart disease, by pneumonia, by tuberculosis, and by epilepsy. But every contribution that is made to the better knowledge of the physiology of pregnancy is of value, and no single work is of greater importance than that which has recently come to us from Professor Paul Bar of Paris.

Bar's work (*Leçons de pathologie obstétricale* (Paris), 1907) contains between 900 and 1000 pages of clinical observations and experimental researches, and, although there is much in it relating to eclampsia and the morbid changes found in that disease, there is also a great mass of materials for the formation of more correct views regarding the physiology of pregnancy than those at present existing. The author has endeavoured to determine the modifications in the nutrition of a healthy mother produced by a normal pregnancy, employing for that purpose *the study of the urine*. With regard, in the first place, to the existence of a *polyuria* of pregnancy, a matter about which there had been doubt, Bar came to the conclusion that it was not a constant phenomenon at the close of gestation, but that it was observed in some primiparas, and that it was common in multiparas; from experimental work upon dogs he discovered that the excretion of water by the kidneys was more abundant during pregnancy than when the animal was not pregnant; and he was therefore of opinion that pregnancy by itself was a cause of polyuria. The *density of the urine* was diminished towards the close of pregnancy; the *solid extractive matters* of the urine were also less in quantity, and Bar ascribed this reduction largely to the fact that the foetus subtracted from the mother certain materials for its upbuilding.

The question of the *nitrogenous interchanges* between mother and foetus was a difficult and complicated one. From observations made upon four pregnant women fed upon a mixed diet, the elements of which were known and in fixed amount, it was found that there was a tendency to a reduction of the residual faecal nitrogen; in a word, there was more complete utilisation of nitrogenous materials in the alimentary tract. These results were confirmed by experiments upon dogs, and this experimental work showed further that the increased utilisation of the nitrogenous material was not regular and steady but occurred in phases. With regard to the urinary nitrogen, and especially to the urea, it was found from experiment that, in pregnant dogs, submitted to a constant dietary, there was diminished excretion of urea in the second half of gestation, and that the decrease was in proportion to the development of the foetus; it was the same in the human subject, and the differences in the results obtained by authors were often to be explained by variations in the amount of food taken. With regard next to the equilibrium of the nitrogenous exchanges during pregnancy, Bar found that the healthy pregnant woman, under a rational regimen, retained some nitrogen and that she retained more than if she were not pregnant



(the other conditions of health, diet, etc., being the same); further, the nitrogenous material that she retained was often greater than was required for the needs of the foetus. The mechanism of this disturbance of the equilibrium of the nitrogen exchange could not be precisely stated; it might be due to a degree of renal impermeability which prevented the excretion of nitrogen, or it might be due to the fixation of nitrogen in the form of albumen. If the latter explanation were the correct one then there would be a real increase in the nitrogen capital (so to say) of the mother in pregnancy.

This peculiarity of the chemical interchanges taking place in gestation led Bar to consider whether pregnancy constituted for the mother a period of loss or of gain. From his own observations, and from those of Hagemann and others, he drew the conclusions that pregnancy did not constitute a period of sacrifice for the mother; that when she was healthy, she found in her diet the necessary elements for the development of the foetus; that when the diet was sufficiently plentiful the healthy mother pregnant of one or more healthy foetuses retained more albumen than the foetus or foetuses required, and of this excess she kept a part for herself; and that therefore the healthy mother carrying one or more healthy foetuses profited from the period of gestation. To this associated condition of the mother and foetus, in which the latter does not live in a parasitic fashion at the expense of the former, Bar gave the name of "harmonious homogeneous symbiosis" (*symbiose harmonique homogène*). The term *symbiosis* was not used in its strict biological sense, which is, that association which gives life to two individuals incapable of living by themselves in the conditions in which they are found, for, of course, the mother could live without the foetus; but Bar had been unable to find a better name. It was a harmonious symbiosis, thus differing from such an inharmonious association as parasitism, in which one of the individuals is a source of injury to the other. Further, it was homogeneous, for the association was that of two individuals of the same and not of different natures. This is a very important deduction for Bar to have made, and is contrary to the idea which is widely held, that foetal life is a parasitic or semi-parasitic state of existence. Apparently it is a unique sort of association. Gestation in the mammalia, says Professor Bar, is perhaps the only, certainly it is the best, example of homogeneous harmonious symbiosis between two beings; the foetus lives upon the mother but also gives to her the power of giving him life without suffering damage herself, indeed she sometimes gains by it. But these deep-seated modifications of nutrition, developing so quickly, maintain the nitrogenous equilibrium or cause a gain to the mother only if the latter be healthy and have a regular dietary. The least weakness of the organism may derange the process and lead to a loss; and the disturbance may come from the side of the foetus as well as from that of the mother. Consequently "foetus sanus in matre sanâ" is the indispensable condition if we would see happy results following the gestational modifications of the nitrogenous nutrition of the individual. If this condition do not obtain, and if the maternal organism becomes supersaturated, so to say, with nitrogenous material in the first half of pregnancy, or if, on the other hand, too little nitrogen is retained, then pathological states (*e.g.* digestive troubles) may arise.

Bar found, further, that the weight of urinary ammonia appeared to increase during pregnancy, and the relation of the nitrogen of the ammonia to the total nitrogen was above the normal. These facts were



due to the pregnant woman taking, by instinct, more food, and to a part of the nitrogen, which ought to have been excreted in the urine as urea, passing to the foetus instead. Primiparous patients excreted more uric acid than multiparous ones, the former excreting a little more than the normal and the latter a little less. In primiparas the relation of the uric acid to the urea and the relation of the nitrogen excreted in the form of uric acid to the total nitrogen were above the normal; these conditions were due to increase in the absolute weight of the uric acid and to a decrease of the urea and of the nitrogen.

Passing to other chemical constituents of the organism, Bar found that the urinary *phosphorus* diminished towards the end of pregnancy, and that the diminution was proportionate to the demands made by the foetus. On the other hand the utilisation in the intestine of phosphorus-containing food was better during the second half of pregnancy than in the first (although it was very good in the first half also); thus the maternal organism was able to store up phosphorus. During pregnancy, therefore, the mother found in her food the phosphorus necessary for the development of the foetus; if she were furnished with sufficient food she did not require to break in upon her capital of phosphorus; and thus there was a harmonious symbiosis in respect to the phosphorus as well as the nitrogen. At the same time Bar believed that the phosphorus equilibrium was, so to say, more precarious than the nitrogen one. With regard to *lime*, it was shown that the pregnant woman's food was generally too poor in that substance to supply the needs of the foetus in the last two or three months, and that the mother, therefore, had to draw from her calcium reserve the greater part of the lime required by her unborn infant. In normal circumstances the loss was not marked; but occasionally the decalcification of pregnancy was prominent and showed itself in the presence of an excess of bases in the blood and in the formation of osteophytes, the occurrence of painful laxity of the joints, and even in osteomalacia. An interesting illustration of these morbid results of gestational decalcification has been given by Marquis (*L'obstétrique*, n. s. i. p. 275, 1908), who found pain in and mobility of the bones of the symphysis pubis, pain on pressure over the iliac crests, etc., in a primipara, 27 years of age, who was excreting  $\frac{4}{9}$  of the lime taken in the food through the faeces; at the eighth month of her pregnancy she was put on a diet rich in lime with the result that the difficulty in locomotion, the progressive loss of strength, etc., were arrested. The patient's blood, in this case, showed nearly double the amount of lime in circulation as compared with a pregnant patient who had no signs of decalcification. The bearing of these observations on the cause and significance of the calcareous placenta is not very evident, for Merletti (*Ann. di ostet. e ginec.*, xxx. p. 577, 1908) found that this abnormality of the afterbirth was met with in healthy as well as in diseased mothers and with foetuses of normal, of excessive, or of deficient development. Merletti, however, observed that, on the whole, the calcareous placenta was most often met with in postmature labours, and it is possible, therefore, that the lime passing from the mother's reserves to the foetus, being no longer needed by the infant, was deposited in the placenta.

To return to Bar's work. The foetal demand for *iron* was great throughout pregnancy but was especially marked in the third trimester. This supply of iron was got directly from the mother's blood. The pregnant woman made provision for this call upon her iron reserves



perhaps by obtaining more iron from her food and certainly by increased activity of the hæmatopoietic organs which had as its result the passage of the iron in reserve into an active form. There was always a risk that this process might overstep normal bounds; then the liver excreted more iron-containing pigments, the fæces contained more iron than was usual, the blood contained more of the iron pigments, and there was a tendency to jaundice. The *sulphur* interchanges were associated with the iron ones. Generally the mother was able to supply the wants of her foetus by obtaining more sulphur from her food and by utilising more thoroughly what she absorbed; but this was not always so, and then the amount of sulphur in the fæces and urine increased. A pathological cycle of events was met with: there was first the foetal demand for iron, followed by excessive hæmatolysis and its results, polycholia, the simultaneous loss of iron and sulphur by the intestine, and finally cholæmia.

As a general rule, Bar found that there was perfect correlation between the needs of foetus for *chloride of sodium* and the retention of that salt by the mother; but the useful and necessary degree of retention was soon exhausted (perhaps from a disturbance of the circulation in renal glomeruli). Urobilinuria was not uncommon towards the close of pregnancy, but the presence of *bile pigments* in the urine was distinctly pathological. There was a slight decrease in the amount of *carbon* excreted by the urine at the same period of pregnancy, due probably to an increase in the retention of sugar, fat, acetone, etc. In pregnancy the glycolytic power was lowered and *sugar* appeared in the urine in about 10 per cent. of primiparas and in about 30 per cent. of multiparas; most often it was glucose, but it was sometimes lactose. Bar was of opinion that the foetus demanded from his mother the *fat* which he fixed, and that a correlation existed between gestational hyperglycæmia in the mother and the presence of a large quantity of fat in the foetus. He came to the following conclusions: the glycæmia of pregnancy was in direct relation to foetal glycogenesis, and indirectly to the development of fat in the foetus; when this glycæmia was proportionate to the power of absorption of the foetus, no glycosuria appeared in the mother; when, however, there was hyperglycæmia, the first result was an increased deposit of fat in the foetus and a large and fat infant was born; and when from any cause (increased glycæmia, morbid states of the foetus, etc.) the passage of sugar through the placenta was insufficient, glycosuria appeared, the "floating" glucose (so to say) finding no employment. Finally, Bar noted that there was frequently a slight degree of *acetonuria* when the pregnant woman was quite healthy and even when the foetus was not dead.

By his prolonged and valuable researches Bar has shown that the physiological condition of pregnancy is a special one and one in which there is a very delicate and easily disturbed equilibrium in the metabolic processes of the body. Under ordinary circumstances, for a healthy mother carrying a healthy foetus and supplied with sufficient food, the period of pregnancy is not one of sacrifice; indeed, under the best conditions, she may draw profit from it; but deviations from the normal are easily set up and may have the most serious effects, among which we must specially keep in mind nitrogenous disassimilation with hyperazoturia and gastro-intestinal disturbance, decalcification, and excessive hæmolysis with cholæmia, etc. It is by means of scientific investigations, such as these, that we may yet be able successfully to combat such serious maladies of pregnancy as hyperemesis, icterus, albuminuria, and eclampsia.



**Pregnancy, Pathology of.**

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SEVERAL important sections of this volume have already been devoted to the consideration of the pathology of pregnancy, *vide* the articles on ABORTION, ANTENATAL PATHOLOGY, CHOREA GRAVIDARUM, ECLAMPSIA, and ECTOPIC PREGNANCY; but there remain certain other sections dealing with morbid states associated with gestation to which some space must here be given.

TRAUMATISM AND SURGICAL OPERATIONS DURING PREGNANCY.—The list of cases of grave injury during pregnancy has been added to during recent years, and amongst the recorded cases are several in which gestation was not interrupted although the traumatism was of a very serious nature. R. P. Harris drew attention to this abdominal and uterine tolerance in pregnant women as shown by the low rate of mortality under severe lacerated and other wounds, in a book published in Philadelphia in 1892; and of recent years several striking confirmatory cases have occurred. Gloninger (*Phil. Med. Journ.*, viii. p. 958, 1901), for instance, reported a pistol-shot wound of the stomach, liver, and transverse colon in a pregnant woman, with recovery and delivery at term; Dreyfoos (*Lancet-Clinic*, n. s. liv. p. 162, 1905) put on record a case of fracture of the base of the skull in a pregnant woman, with recovery, and without the occurrence of abortion; and Wyder (*Corr.-Bl. f. Schweiz. Aerzte*, xxxv. p. 429, 1905) met with the case of a patient (pregnant at term) who fell from a second floor window and received a wound of the head, dislocation of the head of the left radius, and fracture of the pelvis, and who was spontaneously and normally delivered 6 days later, with recovery. To these might be added the remarkable cases of Steele (*Surg., Gynec., and Obstet.*, vi. p. 293, 1908), Smirnoff (*Prakt. Vrach*, ii. p. 1101, 1903), and Hood (*Brooklyn Med. Journ.*, xvi. p. 395, 1902); but it may be regarded as fully proven that severe injuries, even when they affect the abdomen, need not necessarily lead to the premature termination of pregnancy or to the death of the mother or foetus. At the same time much depends upon the skill of the surgeon who is called upon to deal with the case and upon the asepsis of his technique. Having in mind the experiences recorded above and others like them, operators have become bolder in their surgical interference during pregnancy. It is no uncommon procedure nowadays to remove ovarian tumours (cystic, solid, or dermoid) which may be found complicating pregnancy, and many articles dealing with this subject have appeared. Dührssen (*Deutsche med. Wochens.*, xxx. pp. 1529, 1570, 1904) is of opinion that such growths should be removed in pregnancy (or in labour) by vaginal ovariectomy; but if the tumour have developed adhesions, this operation may become suddenly difficult and not free from danger from hæmorrhage. C. Greene Cumston (*Journ. Obstet. and Gynec. Brit. Emp.*, xiv. p. 159, 1908), although operating in four out of his five cases by the abdominal route, is inclined to recommend vaginal ovariectomy in some instances; he points out that the sudden cooling of the peritoneal cavity (in abdominal ovariectomy) may, by relaxing the muscular struc-



ture of the uterus, lead to expulsion of the foetus. Operation early in pregnancy would seem to be safer than in the later months; and A. Martin (*Normandie méd.*, xxii. p. 22, 1907) found in a young primipara at the seventh month of gestation that a dermoid cyst of the right ovary had ruptured and suppurated, necessitating Cæsarean section, ovariectomy, and, ultimately, total abdominal hysterectomy; ovariectomy early in pregnancy would probably have prevented this dangerous sequence of grave operative procedures. But even when the cyst ruptures in pregnancy surgical interference may be successful, thus H. Morestin (*Ann. de gynéc. et d'obstét.*, 2 s. iv. p. 602, 1907) operated (by laparotomy) on a patient at the fourth month of pregnancy and found that there was a ruptured multilocular cyst of the right ovary; labour set in on the second day and the placenta had to be removed, and yet the woman ultimately recovered. It is on account of such experiences that Lobenstine (*Bull. Lying-in Hosp.* (New York), iii. p. 88, 1906-7) advises operation during pregnancy as soon as the diagnosis is established; and the same advice is given by many others (M'Kerron 1903; Munro Kerr, 1908).

But even tumours of the uterus itself have been successfully operated on during pregnancy, *e.g.* Doran's case of sessile subserous fibro-myoma removed by myomectomy at the third month (*Journ. Obstet. and Gynec. Brit. Emp.*, viii. p. 297, 1905), Potocki's case of amputation of the hypertrophied cervix in the fourth month (*Compt. rend. Soc. d'obstét., de gynéc., et de pædiat. de Paris*, vii. p. 186, 1906), and Hewetson's double myomectomy at the tenth week of gestation (*Birmingham Med. Rev.*, xii. p. 55, 1908). Amputation of the cancerous cervix during pregnancy has also been performed, but in 58 per cent. of the reported cases abortion followed (Oui, *Echo méd. du Nord*, xi. p. 229, 1907). There can be no doubt that in some instances fibroid tumours form a very grave complication of pregnancy, and this is especially true of the cases in which torsion of the fibroid or of the whole uterus occurs (Lepage and Mouchotte, *Ann. de gynéc. et d'obstét.*, 2 s. iii. p. 99, 1906; Ivanoff, *Ann. de gynéc. et d'obstét.*, 2 s. iv. p. 311, 1907). Glockner (*Zentralb. f. Gynäk.*, xxxi. p. 156, 1907) has suggested that a myomectomy scar will be a probable cause of uterine rupture in subsequent pregnancies, but Littauer and Abel did not see reason to join in these fears.

DIGESTIVE DISORDERS DURING PREGNANCY.—Quite a considerable literature has grown up round the subject of *appendicitis* as a complication of pregnancy. Schoemaker (*Zentralb. f. Gynäk.*, xxix. p. 596, 1905), in a series of 150 cases of appendicitis (of which 80 were women), noted pregnancy in two, and in one of these death resulted, whilst, in the other, a gangrenous appendix was removed, followed by a slow convalescence. Renvall (*Finska läk.-sällsk. handl.*, Helsingfors, I. i. 1908) has published a valuable summary of over 250 cases of appendicitis occurring either alone or along with peritonitis as a complication of pregnancy and labour; in 163 of these instances an operation took place; he was of opinion that the uterus should generally be emptied before the abdominal section is carried out, especially when the foetus was alive and the pregnancy far advanced. Rostowzew (*Zentralb. f. Gynäk.*, xxvii. p. 1485, 1903), however, and many others, have been opposed to the preliminary induction of abortion; and Monod (*Compt. rend. Soc. d'obstét., de gynéc., et de pædiat. de Paris*, v. p. 70, 1903), for instance, had to free many adhesions and extricate the appendix from behind the cæcum before he could remove it, and yet pregnancy went on to term. Mauclore, Segond, and others (*Ann. de gynéc. et d'obstét.*, ii.



p. 243, 1905) have summed up strongly in favour of immediate operation in cases of appendicitis in pregnancy, and the first-named operator made, on one occasion, as many as four incisions to let out pus, removed a gangrenous appendix, and yet pregnancy was not interrupted. Further, there is evidence that appendicitis, if not operated on during pregnancy, is apt to be aggravated by the traumatism of labour and to become very dangerous in the puerperium (Michel, *Rev. méd. de l'est*, xxxviii. p. 257, 1906).

*Hyperemesis gravidarum* continues to be one of the most dreaded complications of the pregnant state. Its *causation* is still a mystery. Whitridge Williams (*Johns Hopkins Hosp. Bull.*, xvii. p. 71, 1906; *Trans. Amer. Gynec. Soc.*, xxx. p. 229, 1905; *Amer. Journ. Med. Sci.*, n. s. cxxxii. p. 343, 1906) recognises three causal varieties—the reflex, the neurotic, and the toxæmic—of which the last-named is the most serious type and shows a distinct rise in the ammonia coefficient (above 10 per cent.) and calls for the termination of pregnancy. There are, of course, other causes, such as gastric ulcer and gastric cancer and uræmia; but these can generally be excluded, and the diagnosis narrowed down to vomiting of the nervous or of the toxæmic type. Tuszkai (*Berl. Klin.*, xviii. p. 218, 1900) is opposed to the toxæmic theory, and would explain true hyperemesis gravidarum as due to peritoneal irritation, the result of the great stretching to which that membrane is subject by the growing uterus and of the defective nutrition following upon the stretching; but it has to be remembered that great enlargement of the uterus, as in twin pregnancies and hydramnios, is not always accompanied by vomiting. Dufour and Cottenot (*Rev. neurol.*, xvi. p. 1345, 1908) also look to the nervous system for the cause, and record two cases in which the intractable vomiting of pregnancy seems to have been due to locomotor ataxia. There are certainly several facts which point to a neurosis, *e.g.* the cure of certain cases by the performance of a small operation, such as stretching the cervix or applying caustic to it, by suggestion or by the rest cure (Fieux, *Bull. et mém. Soc. de méd. et chir. de Bordeaux*, p. 406, 1907; Scholomowitsch, *Russ. med. Rundschau*, v. p. 517, 1907); but, on the other hand, the toxæmic theory is favoured by the cessation of the vomiting when there is timely emptying of the uterus. The safest conclusion to which to come (in the present state of our knowledge) would seem to be to regard most cases as nervous in origin, but to be prepared for the occasional occurrence of toxæmia as a cause. Under the circumstances *treatment* must necessarily be unsatisfactory, but K. Baisch (*Berl. klin. Wochensch.*, xlv. p. 297, 1907) lays down certain useful rules. Believing, as he does, that there is a special predisposition to intractable vomiting in some pregnant women and that this predisposition resides either in the uterus (overproduction of or alteration in some chemical substance therein), or in the central nervous system (abnormal irritability), or in the stomach (weak digestion in the past), Baisch orders complete rest in bed, sometimes with an icebag on the abdomen; then he withholds all food, solid and fluid, for twenty-four hours, giving saline fluid subcutaneously to relieve the consequent thirst; thereafter food is given with great care, iced milk in teaspoonfuls, dry biscuit, then later tea and coffee with milk, and so on, the return to ordinary diet being very gradual; after these means have been tried, the patient, if uncured, should be placed in a hospital (*e.g.* in the pre-maternity ward of a maternity hospital). Baisch regards scopolamine as the best sedative. When all these remedies fail and the symptoms continue to



threaten the life of the patient, the pregnancy should be interrupted, and Baisch prefers to empty the uterus at one sitting. H. Freund (*Deutsche med. Wochens.*, xxxiii. p. 1625, 1907) also discusses the treatment of the uncontrollable vomiting of pregnancy in great detail; he looks for a predisposing cause in congenital or acquired anomalies of the stomach, in blood diseases and cachectic conditions, in the nervous and hysterical temperament, and in naso-pharyngeal affections. When a woman with such a predisposition becomes pregnant, treatment ought to be begun before the appearance of the vomiting; her medical attendant must keep her under observation and there ought to be a nurse in charge; at first the treatment must be physical and any discoverable anomalies in the genital sphere should be corrected; thereafter, when the hyperemesis is in existence, rest in bed, the wearing of a tight abdominal binder, warm rectal injections of saline, the application of hot alcohol to the epigastrium, and the administration of cacodylate of sodium per rectum or subcutaneously should be relied on. Freund's dietetic and psychical treatment resembles that recommended by Baisch; and the termination of pregnancy is to be a last resort.

Among the rare complications of pregnancy (affecting the digestive system) must now be placed axial torsion of the large intestine, a fatal case of which was recorded by Georg Becker in 1908 (*Monatssch. f. Geburtsh. u. Gynäk.*, xxviii. p. 155, 1908). The patient was 45 years of age, and was pregnant for the fifteenth time. She had twice given birth to twins. In the eighth month of gestation abdominal pain came on followed by vomiting, and there were all the signs of intestinal obstruction; the cervix was dilated and a dead female foetus was removed; the mother died five hours later. At the necropsy the sigmoid flexure, which had a long mesocolon, was found to be twisted on the axis of the mesentery and to be in a gangrenous state. Becker has gathered together from literature seven other cases, all of them, with one exception, fatal.

*Acute Yellow Atrophy of the Liver* is associated in some measure with both eclampsia and hyperemesis gravidarum. Like them, it is obscure in its etiology and generally fatal in its issue. Amongst several contributions of value which have been made to the understanding of it within the past few years may be named Bertino's paper (*Ginecologia*, v. pp. 417-448, 1908). In this article ten cases of icterus gravidarum were recorded, of which seven were benign, one was serious from the first and proved fatal, and two became serious although benign at first and both ended in death. Bertino came to the conclusion that in cases of epidemic or sporadic icterus in pregnancy the disease, although apparently benign, might very easily be transformed into the grave type and run the course of acute yellow atrophy of the liver. The prognosis, therefore, should always be doubtful. The presence of twins in the uterus (as in the immediately fatal case recorded by Bertino) or of diseases of the blood help to determine hepatic inadequacy in pregnancy, and so change a simple jaundice into the grave type. When the symptoms are well established, neither medical nor obstetrical treatment is of much avail. The hepatic complications of pregnancy have also been discussed by Brauer (*Zentralb. f. Gynäk.*, xxvii. p. 787, 1903), Charles (*Journ. d'accouch.* (Liège), xxvii. p. 73, 1906), Kehrer (*Arch. f. Gynaek.*, lxxx. p. 129, 1907), Lulle (*Journ. de méd. de Paris*, 2 s. xviii. p. 201, 1906), Rudaux (*Arch. gén. de méd.*, i. for 1905, p. 1191), and Hofbauer (*Med. Klin.*, v. p. 239, 1909).



RENAL DISORDERS DURING PREGNANCY.—In addition to their relation to ECLAMPSIA (*q.v.*), the kidneys may be at fault in pregnancy in other ways. The *movable kidney*, for instance, may become impacted in the pelvis during pregnancy. Von Guérard (*Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 1160, 1903) has recorded such a case: the patient suffered from a fall on the nates, followed by great pain; a tender mass impacted in the pelvis was discovered on examination; it was thought to be ovarian, and was reduced under anæsthesia; two months later the same conditions were redeveloped; the abdomen was opened, the tumour (the right kidney) was reduced, and both the Fallopian tubes were ligatured; the patient aborted three hours later. *Pyelitis* and *pyelonephritis* may occur as complications of pregnancy. Cumston (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. p. 221, 1905) has ably summarised our knowledge on these maladies and has recorded a personal observation of persistent pyuria in which decapsulation of both kidneys was performed but without saving the patient; prior to decapsulation the uterus had been emptied (the gestation was at the sixth month), and, prior to this, ovariectomy had been performed successfully at the fifth month. Opitz (*Berl. klin.-therap. Wochensch.*, p. 1357, 1904), Fournier (*Bull. Soc. d'obstét. de Paris*, viii. p. 9, 1905), Rudaux (*Clinique* (Bruxelles), xx. p. 522, 1906), Bar and Daunay (*Bull. Soc. d'obstét. de Paris*, ix. p. 136, 1906), and Esselbruegge (*Med. Fortnightly*, xxxiii. p. 17, 1908) have made contributions to this department of the pathology of pregnancy. There have been several important articles on glycosuria in the pregnant state, amongst which may be named those by Rudaux (*Clinique*, i. for 1906, p. 281), Jackson and Torbert (*Boston Med. and Surg. Journ.*, clii. p. 159, 1905), Brook (*Trans. Obstet. Soc. Lond.*, xlviii. p. 192, 1907), Loviot (*Rev. d. mal. de la nutrition*, 2 s. ii. p. 173, 1904), Eshner (*Amer. Journ. Med. Sci.*, cxxxiv. p. 375, 1907), and Williams (*Amer. Journ. Med. Sci.*, cxxxvii. p. 1, 1909).

The Goulstonian Lectures on the influence of pregnancy upon certain *medical diseases* and of certain medical diseases of pregnancy by Dr. Herbert French (*Brit. Med. Journ.*, i. for 1908, pp. 1029, 1100, 1165) are worthy of special consideration; pyelonephritis and the fevers are specially dealt with.

## Prescribing, and Methods of Administering Drugs.

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### PRESCRIBING

GENERAL PRINCIPLES.—Many years ago Dr. Paris summarised the aim of prescribing—that is, the art of combining medicinal substances—



as:—(1) To augment, correct, or modify the action of a drug; (2) to obtain the joint action of two or more diverse remedies; (3) to form a new remedy; (4) to obtain a suitable form. Applications of these principles readily suggest themselves; thus combinations of purgatives each of which operates in a different way are more effective than single drugs, while in the same manner chloral and opium together act as a hypnotic with less disturbance to other functions than is produced by a sufficient dose of either given separately. Again, a cough mixture may contain morphia to allay the cough, and ipecacuanha to facilitate expectoration, while combinations containing ferrous sulphate and an alkaline carbonate form a new remedy—ferrous carbonate.

There is no doubt that skill in the art of writing prescriptions is cultivated to a less extent now than in a former generation: for this there are several reasons. A more scientific therapeutics has led to the use of simpler formulæ, and prescriptions containing only one or two drugs are much more common than in the past. Polypharmacy has declined, and with it some of the rather mystical importance attached to an “elegant” prescription. At the same time, the constant influx of new synthetic remedies, and the exploiting of what should be the domain of the physician by the manufacturing chemist in the production of combinations of drugs in forms more attractive and convenient than the six-ounce mixture, have still further contributed to inducing practitioners to order quasi-proprietary remedies (and excellent many of these preparations are) in preference to thinking out an appropriate prescription for the case in hand.

No one will deny that the modern pharmacy is a great advance upon the old, and instead of railing at the general use of drugs in tablet and other forms by the public, the duty of the medical man is to correct his own ways, and to adapt to his own prescriptions the newer methods of the pharmacist, as a very little forethought will enable him to do.

**WEIGHTS AND MEASURES.**—The weights and measures in common use in this country for prescriptions are the grain (gr.), the drachm ( $\mathfrak{z}\text{j} = 60$  grs.), and the ounce ( $\mathfrak{z}\text{j} = 8$  drs.). The scruple ( $\mathfrak{d}\text{j} = 20$  grs.) is practically obsolete. For fluid measure we have the minim ( $\mathfrak{a}\text{j}$ ), the fluid drachm (fl.  $\mathfrak{z}\text{j} = 60$  min.), and the fluid ounce (fl.  $\mathfrak{z}\text{j} = 8$  drs.). These are troy or apothecaries’ weight; in the Pharmacopœia only the avoirdupois weight is recognised, which differs from the preceding in having  $437\frac{1}{2}$  grs. to the ounce, and 16 ozs. to the pound, instead of 480 grs. and 12 ozs. respectively. In prescribing, however, the apothecaries’ or troy system is used. Advisable though the decimal system may be for other purposes, it has not as yet, in this country, made much headway as a means of writing prescriptions. One practical drawback to its use is that, while to reap the full advantage of a decimal prescription the mixture must be made up in ten or a multiple of ten doses, yet since we order the doses to be taken at stated intervals of time, which is reckoned on a duodecimal system, it is generally more convenient to give three, four, six, or twelve doses, to be taken at corresponding hourly intervals, than to give five or ten. On the other hand, it is very often convenient to order drugs for external application as percentages, in which case we may either adopt the metric system of weights, or prescribe so many parts per cent. of each ingredient, and direct the dispenser to dispense an ounce or more of the combination. Tables for the conversion of the decimal to other systems, and *vice versa*, are so readily accessible that it is unnecessary to give them here. It should, however,



be remembered that a gramme is just about equal to 15 grains (15·432) and a cubic centimetre to 17 minims (16·9), while a milligramme equals  $\frac{1}{64}$  grain and a centigramme about  $\frac{1}{8}$  grain.

As domestic measures the tablespoon, dessertspoon, and teaspoon are commonly treated as the equivalents of half an ounce, two drachms, and one drachm respectively. The use of a correctly graduated measuring glass is, however, advisable. An ordinary tablespoon contains about six drachms, a dessertspoon three drachms, and a teaspoon one and a half drachms; an afternoon teaspoon holds somewhat less than a drachm. A liqueur glass holds practically an ounce, and a sherry glass about two ounces and a half. These measures are fairly constant. The size of a drop varies greatly according to the viscosity of the fluid; it is a very rough measure of a minim. Thus while water gives 50 or 60 drops to the drachm, alcohol, tinctures, and fluid extracts give about 140, and chloroform gives 250. It may at least be said, therefore, that when drops are counted as minims there will be no likelihood of over-dosage.

**TYPES OF PRESCRIPTIONS.**—The technique of prescription writing may best be illustrated by taking a typical example, such as the well-known cough mixture of the Brompton Hospital. In its unabbreviated form it runs:—

<i>Superscription</i>	Recipe.	
<i>Inscription</i>	Liquoris Morphinae Hydrochloridi	drachmas duas ( <i>Basis</i> ).
	Acidi Hydrocyanici Diluti	drachmam unam ( <i>Adjuvant</i> ).
	Syrupi Tolutani	unciam unam ( <i>Corrective</i> ).
	Infusum Rosæ Acidum ad uncias sex	( <i>Vehicle</i> ).

*Subscription* . Misce.

*Signature.*—Signa (or Signetur)—One tablespoonful to be taken in water every four hours.

Initials of Prescriber.

Patient's Name and Address.

Date.

The above illustrates the classical component parts of a prescription. We have first the *Superscription*—Recipe; next, the *Inscription* or body of the prescription, with its *Basis* (the morphia), its *Adjuvant* (the dilute hydrocyanic acid), its *Corrective* (the syrup of tolu), and its *Vehicle* (the infusion of roses). Then comes the *Subscription* or direction to the dispenser—Misce; and finally, the *Signature* or instructions to the patient. The objects of the four ingredients are sufficiently indicated by the words basis, adjuvant, corrective, and vehicle; and although not all prescriptions contain these, the traditional plan of combining four substances is still very frequently followed.

*Grammar of a Prescription.*—The Latin required for a prescription is extremely simple, and the tendency is more and more to limit it. The above illustrates some of the chief points to be attended to. Recipe is the second person singular of the imperative mood of the verb *recipio*, and means “take thou.” The contraction *R* by which it is replaced in everyday work is the symbol of Jupiter—the last relic of the mediæval physician-astrologer's invocation of planetary help and guidance. The



names of the first three drugs are in the genitive—of the liquor of the hydrochloride of morphine, etc.—and the quantities of each in the accusative, after the active transitive verb *recipio*. The vehicle is generally written in the accusative and followed by *ad* when not an exact quantity, but only the amount requisite to bring the whole mixture up to a given bulk is stated. The convenience of this is obvious, since when solids are ordered by weight their bulk is not so precisely known as to make it possible to say how much fluid must be added to yield (say) six ounces. All drugs, however, of which the required amount is exactly stated, should be put in the genitive, the word *ad* being omitted.

In the usual contracted form the prescription would run thus:—

18th January 1906.

R Liq. Morph. hydrochlor. ʒij.  
 Acid. hydrocyan. dil. ʒj.  
 Syr. Tolu. ʒj.  
 Inf. Rosæ acid. ad ʒvi. M.

*Sig.*—One tablespoonful in water every four hours.

Mrs. SMITH,  
 10 High Street.

A. B.

The directions to the patient are seldom now written in Latin, but, as we have said, the custom of using that language for the body of the prescription still obtains. This is perfectly defensible on two grounds: first, it prevents the patient from knowing exactly what he is getting—often a very desirable matter; second, it enables a pharmacist unacquainted with English to dispense the prescription. It is rarely necessary now to give minute directions as to pharmaceutical procedures, hence the Latin of the subscription is greatly simplified. Practically all the phrases in common use are given in the table on page 371 (Table I.).

The following formulæ (which are given uncontracted) will serve to exemplify further what has been said, and to indicate the most common modes of expressing prescriptions:—

Recipe, Tincturæ digitalis

Tincturæ nucis vomicæ, ana . drachmam unam.  
 Spiritus ammoniæ aromatici . drachmas sex.  
 Aquæ . . . . . uncias duas.

Fiat Mistura.

*Signa.*—A dessertspoonful in water every four hours.

Recipe, Santonini . . . . . grana quatuor.

Hydrargyri subchloridi . . . . . grana sex.

Misce et divide in pulveres quatuor.

*Signa.*—One powder to be taken at bedtime.

Recipe, Podophylli resinæ . . . . . Semi granum.

Extracti hyoscyami . . . . . Granum unum cum semisse.

Fiat pilula secundum artem. Mitte tales duodecim.

*Signa.*—One to be taken after dinner.

In contracted form the last would run:—

R Podophyll. res. gr. fs.

Ext. hyoscyam. gr. i fs.

F. pil. sec. art. Mitte tal. xii.

*Sig.*—One to be taken after dinner.



One or two other practical points call for notice. Prescriptions should be clear. This is only attainable by legible writing and the avoidance of such ambiguous contractions as *Ac. hyd. dil.*, which may mean either hydrochloric or hydrocyanic acid; *Chlor. hyd.*, which may mean chloral hydrate, calomel, or corrosive sublimate, and the like.

When the physician does not wish a prescription to be repeated without his sanction—*e.g.* in the case of morphia, cocaine, etc.—it is usual to add to the subscription the words *Non rep.*, for “non repetatur.” In the case of poor persons, to whom the cost of medicine may be a

TABLE I.

Contraction.	Latin.	English.
āā . . .	ana . . . . .	of each.
ad . . .	. . . . .	to, up to.
ante cib. . .	ante cibos . . . . .	before food.
Aq. . . .	Aqua . . . . .	water.
aq. dest. . .	aqua destillata . . . . .	distilled water.
bis die . . .	bis in die . . . . .	twice daily.
caps. . . .	capsula . . . . .	capsule.
collyr. . . .	collyrium . . . . .	an eye-wash.
c̄. . . . .	cum . . . . .	with.
div. in part. æq. . .	divide in partes æquales . . . . .	divide into equal parts.
ft. . . . .	fiat, fiant . . . . .	let it (them) be made.
garg. . . .	gargarisma . . . . .	a gargle.
haust. . . .	haustus . . . . .	a draught.
M. . . . .	misce . . . . .	mix.
mass. . . .	massa . . . . .	a pill mass.
mitte . . . .	. . . . .	send.
mit. tales . . .	mitte tales . . . . .	send of such.
non rep. . . .	non repetatur . . . . .	not to be repeated.
pt. æq. . . .	partes æquales . . . . .	equal parts.
post cib. . . .	post cibos . . . . .	after food.
p. r. n. . . .	pro re nata . . . . .	as needed.
q. s. . . . .	quantum sufficit . . . . .	as much as is sufficient.
rep. . . . .	repete . . . . .	repeat.
sec. art. . . .	secundum artem . . . . .	according to art.
semi-(gran.) . . .	semi-(granum) . . . . .	half-(a-grain).
fs. . . . .	(granum unum cum) semisse . . . . .	(one grain and) a half.
Sig. . . . .	Signa, Signetur . . . . .	write, let it be marked.
S. . . . .	solve . . . . .	dissolve.
t. i. d. . . .	ter in die . . . . .	thrice daily.

serious consideration, the insertion of the letter “P” in the subscription may be used to indicate this; most druggists dispense prescriptions so marked at the lowest possible price, but it should be remembered that this is an act of grace, and that the courtesy ought never to be abused. The name and address of the patient should always be written on the prescription.

The *directions to the patient* ought to be written in full, invariably stating *how* (in water, etc.) and *when* (at what intervals, or in what relation to food) the doses are to be taken. The hasty “as directed” is



too often a cloak for negligence, and when it is used the prescriber ought to be sure that the patient really has received such instructions as may enable him to use the medicine as was intended. Still, when ordering remedies for use in menstrual disorders, urethral discharges, etc., it is obviously undesirable to write explicit directions on the prescription: here, "as directed" finds a proper sphere.

In ordering a medicine it is usual to state whether it is to be taken before or after food, and in doing so we are guided by the effect which we wish to produce. If a local effect on the stomach is desired, or if we wish the drug to act rapidly, it should be given on an empty stomach. On the other hand, drugs which are in any way likely to irritate the stomach or disturb digestion should be given after a meal, so that they may be diluted by the gastric contents. In the case of drugs given for the express purpose of influencing digestion, the time at which they are taken depends on the circumstances of each case. Thus alkalies given to correct acidity are administered at a short interval after a meal; hydrochloric acid, to remedy defective gastric secretion, during meals; saline aperients, again, should be taken in the morning, while fasting.

Drugs given in small bulk and soluble form are more rapidly absorbed than when insoluble or much diluted.

*Dosage.*—The two principal factors influencing dosage are the *Age*, or size, of the patient, and *Susceptibility*.

*Age.*—Strictly speaking, it is the bulk of the patient, rather than his age, which should affect the dose; but in practice not much account is usually taken of this, further than that on the whole a somewhat smaller dose of a drug is generally given to a woman than to a man. In the case of children the usual custom is to give a fraction of the adult dose equal to  $\frac{x}{x+12}$ , where  $x$  = age. Thus if a drachm be the adult dose of

a remedy, to a child of four we should order  $\frac{4}{4+12}$ , or one fourth of a drachm. Other methods of reckoning the dosage for children have been suggested, but the above, which is applicable to most drugs (the chief exceptions are noted below), is as simple and satisfactory as any. In old age smaller quantities of most drugs (except aperients) are required than in the young adult, but no definite rules can be laid down.

*Susceptibility.*—This is influenced chiefly by age, sex, certain physiological conditions, and personal idiosyncrasy.

*Age.*—Children, as is well known, are peculiarly intolerant of certain remedies, yet bear relatively large doses of others. In the former category the chief place must be given to opium, which ought to be administered to infants and young children with great caution. At one year  $\frac{1}{2}$  to 1 minim of laudanum is an average dose; compound tincture of camphor may be given during the first year to the extent of one minim for each month, while at one month about  $\frac{1}{20}$  minim of laudanum may be administered. Digitalis, quinine, alcohol, strychnine, and mercury are well borne by children; while purgatives, chloral, antipyrin, arsenic, and belladonna are tolerated in doses relatively much larger than by adults. In the aged, who so often suffer from bronchial catarrh, thickened vessels, and inadequate kidneys, opium must be employed with caution. Tonics are seldom well borne, in particular those containing strychnine. This drug should indeed be given in very small doses to old people, whether as a stimulant in acute illness, or as a tonic in debility.



*Idiosyncrasy.*—The chief drugs towards which patients may be expected to show personal idiosyncrasy are antipyrin and antifebrin, quinine, bromides and iodides, cocaine, belladonna, arsenic, iron, and copaiva.

Such physiological states as *pregnancy* and *lactation* are reputed to be influenced by certain drugs, hence care should be taken in prescribing during those periods. In pregnancy, drugs such as ergot, quinine, drastic purgatives, and lead ought to be given cautiously for fear of producing abortion, while during lactation saline aperients and belladonna, which may interfere with the secretion of milk, ought to be avoided. Certain drugs, too, are excreted by the mammary glands, and may thus affect the infant. The importance of this has probably been greatly overrated. Thiemich (*Monatssch. f. Geburtsh. u. Gynäk.*, Bd. x., 1899), in a critical review of the whole subject, shows that the only drugs which assuredly pass over in the milk are salicylates and iodides. In one instance it seemed as though mercury also did so. Briensa (*Zeitsch. f. Exp. Path. u. Ther.*, Bd. iv. Hft. 2, 1907), after administering medicinal doses of a large number of drugs to nursing women, could detect only iodides, bromides, iron, arsenic, aceto-salicylic acid, and calomel (as mercury) in the milk. Experimentally, traces of opium, atropine, and (when given in toxic doses) alcohol have been detected in the milk, but so far as the therapeutic administration of drugs to nursing women is concerned the only ones in which this question need be considered are salicylates and iodides, rhubarb and senna, which may cause catharsis in the infant, and thyroid extract, which has produced symptoms of thyroidism in the breast-fed infants of mothers taking the drug.

*TOLERATION.*—After long-continued administration, particularly in the case of opium and hypnotics, the effects of a drug become less evident, and the dose may have to be increased.

*CUMULATIVE ACTION.*—The duration of action and the rate of excretion influence the amount of a drug which can be administered with safety in a given time. When the drug acts rapidly and for a short time only the dose may be repeated frequently. On the other hand, if, as in the case of digitalis, the action develops slowly and is more enduring, it is inadvisable to repeat the drug at too short intervals. When drugs are excreted slowly they are apt to accumulate in the body, and their administration may have to be suspended for this reason. A knowledge of pharmacology is the only guide in this matter.

#### CORRECTION OF FLAVOUR, COLOUR, AND ODOUR.

*Palatability.*—According to Freyberger, who has specially studied the best methods of correcting the tastes of nauseous drugs in view of the necessities of prescribing for children, the most powerful flavouring agents seem to be those derived from oranges, ginger, peppermint, cinnamon, liquorice, and tolu. Perhaps the most generally useful are fluid extract of liquorice, syrup of oranges, and compound tincture of cardamoms. Children, as a rule, dislike peppermint, which, like ginger, is generally palatable to old people. At times, where the administration of alcohol is desired, or at least not disadvantageous, a liqueur of pronounced flavour, such as chartreuse or curaçoa, may render a mixture pleasant. Drugs which are extremely nauseous are best administered in capsules or cachets. Thus it is almost impossible to conceal the taste



of paraldehyde or viburnum, though the former is to some extent masked by almond mixture.

The following may be useful for reference:—

Ammonium carbonate, atropine, belladonna, calumba, cinchona, bitters in general, chloral, codeine, digitalis, strophanthus, the scale preparations of iron, guaiacum, hamamelis, morphine, quinine, strychnine, antipyrin, salicylates, salicin, bromides, bicarbonates, liquor trinitrini, nux vomica, and dilute acids are most effectually concealed by *Syrup of Oranges*.

Aloes, ammonium chloride, benzoin, cascara, and strychnine are masked by *Fluid Extract of Liquorice*.

Atropine, ergot, Epsom salts, laudanum, male fern, rhubarb, senna, strychnine, sulphuric acid, tannic acid, and terebene may be rendered more palatable by *Syrup of Ginger*.

Antipyrin, bicarbonates, boric acid, diuretin, iodides, and the liquor hydrargyri perchloridi may be concealed by *Peppermint Water*.

Bicarbonates, camphor, catechu, codeine, kino, and male fern may be disguised by *Cinnamon Water*.

The following are also fairly palatable combinations:—Ammonium bromide with syrup of oranges and chloroform water. Ammonium carbonate or benzoic acid with syrup of tolu. Ichthyol with oleum citronellæ. Butyl chloral hydrate with glycerine and compound tincture of cardamoms. Chloral with syrup of virginian prunes and cinnamon water. Copaiva with mistura amygdalæ. Astringent iron preparations with glycerine. Sulphate of iron with dilute sulphuric acid and syrup of ginger. Tincture of belladonna or hyoscyamus, or chlorate of potash, with syrupus mori. Menthol and sugar. Cod-liver oil with essence of almonds and lemon. Ammoniated tincture of opium with aniseed water. Phosphoric acid or acetate of potash with syrupus rubi idæi. Castor oil or salicylic acid or dilute sulphuric acid with syrup of ginger and cinnamon water. Senega with syrup of oranges and chloroform water. Spiritus ætheris compositus or spiritus ætheris nitrosi with aqua carui or aqua camphoræ.

*Colouring Agents*.—It is seldom necessary to add anything to give colour to a mixture, but sometimes, as in the case of apomorphine, which may yield a green solution unless a few drops of hydrochloric acid be added, the colour may with advantage be modified by the addition of liquorice or acid infusion of roses. Unexpected colour reactions are not infrequent in mixtures containing such coal-tar derivatives as antipyrin and antifebrin, hence it is generally advisable to give these in as simple a form as possible.

*Odour*.—It is comparatively rare for the odour of a drug to be so objectionable as to require concealment. The singularly clinging smell of iodoform may be disguised by Tonga bean or its active principle coumarin; one grain of the latter may be added to 50 grains of iodoform. Fluid extract of viburnum ought never to be prescribed as such, on account of its offensive smell, which suggests defective sanitation. It is most frequently given in capsule, or in the form of the proprietary remedy known as liquor sedans.

*INCOMPATIBILITY*.—Incompatibility may be pharmaceutical, pharmacological, or chemical: of these, the last is by far the most important. In prescribing new and unfamiliar drugs it is extremely easy to write an incompatible prescription, and in many cases no blame can be attached to the prescriber for doing so. As a general rule, such errors



are detected by the dispenser in making up the prescription, whereupon it is customary for him, unless, as is often the case, he can by skilful compounding get over the difficulty, to communicate with the physician in order that the mistake may be rectified. It is also comparatively rare for an incompatible combination of drugs to do harm; more frequently the mixture is inert from the formation of insoluble bodies, or else is in such a form as to be difficult to administer. Practically, the chief dangerous incompatibilities are those in which alkaloids are precipitated, and therefore cease to be evenly distributed throughout the mixture, and those in which cyanides may be formed. Among minor chemical incompatibilities, changes of colour may be mentioned, as, for example, when borax is combined with acid infusion of roses, giving a bright green colour.

Incompatibility is best avoided by simplicity in prescribing, particularly in the choice of the solvent or excipient; both alcohol and water lose their solvent power for the particular substances each dissolves, in proportion to the amount of the other present. Obviously, a drug should never be prescribed with its test or antidote.

TABLE II.

	Incompatible with			
Watery infusions and decoctions.	Resinous tinctures and fluid extracts.	Chloroform.	Volatile and fixed oils and balsams.	
Mucilage.	Tannic acid.	Solutions of lead and iron.	Spirit of nitrous ether.	Alcohol, glucosides, oxalates, carbonates.

*Pharmaceutical Incompatibility.*—Water is a solvent for albuminous, mucilaginous, gelatinous, and saccharine bodies generally, and for most inorganic salts. Its power of dissolving these is diminished by the presence of alcohol. Alcohol is a solvent for oils, resins, gum-resins, and balsams, and its power of dissolving these is diminished by the presence of water. Essential oils cannot be dispensed with water in the proportion of more than one minim to the fluid ounce. Fixed oils, oleo-gum-resins such as copaiva, and alcoholic extracts of resinous bodies can be combined with water only by the addition of an excipient to suspend them. Alcoholic tinctures of diverse strengths should not be mixed, and strong tinctures do not combine well with water. The aquæ of the pharmacopœia are already saturated. Compound infusion of gentian is incompatible with infusion of cinchona. Acids should not be prescribed with liquorice, as the glycyrrhizin is precipitated. Water decomposes the glycerine of boracic acid. Salts of alkaloids should not, as a rule, be prescribed with oils or fats; the alkaloidal base itself should be used.

*Pharmacological Incompatibility.*—It is unnecessary to say much on this head. It is apparent that to prescribe two active drugs which neutralise each other may defeat the aim of the physician, and to avoid this a knowledge of pharmacology is the only guide. In many cases,



TABLE III.

The drugs in this vertical column are incompatible with. . . . .	Tannic and gallic acids.	Alkalies.	Alkaloids and their salts.	Acids.	Spiritus ætheris nitrosi.	Metallic salts.	Iodides.	Acetates	Tincture of guaiacum	Albu- min	Antipyrin	Mucilage	Glucosides
Tannic and gallic acid .		"	" (not gallic)	Concentrated mineral	"	Most metallic salts and oxides		Acetates			Antipyrin		
Alkalies . . . . .	"		"	Acids		"		Weak salts	Aqua lauracerasi		Chloral (= evolution of CHCl <sub>3</sub> )		
Carbonates and carbonic acid . . . . .	"		" (except codeine)	" (except HCN)		Bismuth sub-nitrate and metallic salts			Syrup of squills				
Lime water . . . . .	"	Alkaline carbonates.	"	"		Mercurial and other metallic salts		Arsenites					
Alkaloids . . . . .	"	Alkalies		Boric and phosphoric acids			"	Bromides, borax				Oxidising agents	
Quinine salts . . . . .	"	"					"	Acetates					
Morphine salts . . . . .	"	"			"	Lead sub-acetate.	"	Borax					Decomposed by codeine
Strychnine salts . . . . .	"	"					Potassium iodide	Bromides					
Free acids and acid salts	"	"				Metallic oxides, hydrates, and carbonates		Relatively weak or volatile salts	Syrup. ferri phosphatis	Albu- min		Tinctures, except in small amount	Glucosides
Dilute hydrocyanic acid . . . . .						Many metallic salts					Antipyrin		
Phosphoric acid . . . . .		"	"			Many metallic salts			Syrup. ferri pyrophosphatis			Lime water	
Spiritus ætheris nitrosi .	"					Sulphate of iron	"	Salicylates	Tincture of guaiacum		Antipyrin	Mucilage	Morphine salts



Mercuric chloride . . .	”	”	”	Hydrocyanic acid (= bicyanide of mercury)	”	Lead and iron salts	”	”	Arsenites, phosphates, sulphides, borax	Albu- min	Antipyrin	Soap	
Calomel . . .	”	”	”	Except acetic and nitric acid	”	”	”	Lead and iron salts	Arsenites		Antipyrin		
Silver nitrate . . .	”	”	”	Acids	”	Many metallic salts	”	”	Arsenites and chlorides			Undistilled water	
Arsenites (Fowler's solution) . . . .	”	”	”	”	”	”	”	”	Hypophosphites in acid mixtures			Lime water	
Iodine and iodides . .	”	”	”	”	”	”	”	”	Chlorates (= poisonous iodates)		Paraldehyde	Starch	
Alum . . . .	”	Alkalies and alkaline carbonates	”	”	”	Lead salts	”	”	Tartrates, and alkaline phosphates			Lime water	
Salicylates . . . .	”	”	”	”	”	Many metallic salts	”	”	”		Antipyrin (deliquesces)		
Digitalis . . . .	”	”	”	”	”	Iron salts and lead acetate	”	”	”				
Chloral . . . .	”	”	”	Dilute hydrocyanic acid	”	”	”	”	”		Alcohol (= alcoholate)		
Antipyrin . . . .	”	Sodium hydrate and bicarbonate	”	Mineral and phosphoric, and hydrocyanic acids	”	Lead and iron salts, calomel, arsenic	”	”	Benzoates		Chloral		
Alkali phosphates . .	”	”	”	Mineral and acetic acids	”	Metallic salts	”	”	”				
Guaiacum . . . .	”	”	”	”	”	”	”	”	”			Oxidising agents	
Creosote . . . .	”	”	”	”	”	”	”	”	”			Oxidising agents	
Codeine . . . .	”	Alkalies, except carbonates	Morphine salts	Mineral acids	”	Iron, lead, etc.	”	”	”				



however, drugs which are in some respects physiologically antagonistic are prescribed together with a definite object, as for example bismuth and rhubarb, when the latter is intended to prevent the constipating effect of the former, and digitalis and iodide of potash, in which the salt is believed to antagonise the action of the digitalis on the vessels.

*Chemical Incompatibility.*—To avoid this a knowledge of elementary chemistry is required. The more common instances of chemical incompatibility are given in Table III. In addition, the following points should be noted.

(1) Any combination must be avoided which will yield the following insoluble salts:—Hydrates, phosphates, borates, carbonates, tannates, and arsenates of the earthy or heavy metals, or alkaloids; sulphides of the metals; sulphates of calcium and lead; mercurous salts; haloid salts of bismuth, silver, or lead.

(2) Powerful oxidising agents ought not to be combined with substances which are readily reduced; admixtures of such bodies in the dry state may cause an explosion. The following are the chief oxidising and oxidisable substances employed in pharmacy:—*Oxidisers*—Chlorine; strong hydrochloric, nitric, and nitro-muriatic acids; chlorates, hypochlorites, permanganates, nitrates, bromine, iodine, bromates, iodates, oxide of silver, peroxides. *Oxidisable*—Phosphates, hypophosphites, sulphur, sulphides, glycerine, sugar, alcohol, oil, ether, creosote, charcoal, tannin, arsenious acid, cyanides, ferrous and mercurous salts.

(3) Explosions from the evolution of carbonic acid are liable to occur when carbonates are dispensed with acid salts or acids in tightly corked bottles. This is most likely to take place by inadvertently dispensing one of the salts mentioned under (5), or the syrup of squill, with an alkaline carbonate.

(4) Weak acids or bases are decomposed by stronger ones, so that salts in solution exchange their radicles, especially if by doing so an insoluble compound can be formed.

(5) The following salts are acid in reaction:—Alum, bismuth subnitrate, ferric chloride, citrate of quinine and iron, ferrous sulphate, lead acetate and nitrate, quinine bisulphate, zinc sulphate.

(6) Alkaloids are precipitated by alkalies. Iodides, particularly double iodides (*e.g.* potassio-mercuric iodide), bromides, tannic acid, benzoates, and salicylates are likely to produce insoluble salts of most alkaloids. The precipitate is soluble in alcohol. Caffeine is not precipitated by iodides. Acetate of quinine is almost insoluble.

## METHODS OF ADMINISTERING DRUGS.

### I. *By the Mouth.*

(1) *Mixtures.*—In mixtures the drugs are dissolved or suspended in a suitable menstruum, usually water or alcohol. A general acquaintance with the solubility of the various drugs is presupposed; for additional information a table of solubility must be consulted. It is usual to prescribe mixtures containing 12 or 16 doses of half an ounce or two drachms respectively; though convention favours the six-ounce mixture, it will, as a rule, be found more convenient to prescribe four ounces of the smaller dose.

When the mixture contains insoluble substances some excipient



should be added to suspend them. The best of these are glycerine, syrup, and gum-tragacanth, which is preferable to acacia for suspending bismuth. One ounce of glycerine may be added to a six-ounce mixture; of tragacanth powder,  $1\frac{1}{2}$  to 2 grains to the ounce is enough. It is not generally known that the addition of a few grains of powdered chalk increases the amount of bismuth which can be suspended in a given bulk of fluid. It is thus possible to give  $7\frac{1}{2}$  grains of bismuth in a drachm—an advantage in prescribing for children.

(2) *Emulsions*.—These are mechanical suspensions of oils or resins in a state of fine division, giving fluids of the appearance and consistency of cream. The excipients most commonly employed are mucilage, yolk of egg, almond mixture, and alkalies. The last, however, as they act by saponifying part of the fat, should as far as possible be avoided. Tincture of quillaia is a suitable excipient for paraldehyde and many oils; for cod-liver oil, yolk of egg is the best, but as the making of a good emulsion is a matter requiring considerable skill, it may to a large extent be left to the pharmacist. Moreover, many of the drugs which are given in this form may equally well be dispensed in capsule. Acids, metallic salts, and large quantities of alcohol are inimical to the process of emulsification.

(3) *Pills*.—Drugs which are nauseous, or insoluble, such as extracts or resins, may be ordered as pills, but this mode of exhibition is unsuitable for bulky substances and efflorescent or deliquescent salts. Thus administered, drugs act slowly, often only after passing out of the stomach. In prescribing pills it is perfectly legitimate to leave to the compounder the choice of the excipient—far better to do so than to order an unsuitable one. Nevertheless, the following hints may be of service to those who prefer to give the directions themselves.

*Confection of roses* is adapted for dry, heavy powders, and generally when a somewhat pasty excipient is wished. *Glycerine of tragacanth* and *syrup of glucose* are very widely useful; so also are *vegetable extracts*. *Liquorice powder*, or *liquorice* and *compound tragacanth powder*, are suitable when moisture is required to be absorbed. *Soap*, or *soap with magnesia*, forms a good pill mass with many essential oils. Resinous extracts, gum-resins, etc., may be formed into pills with the addition of a little *alcohol*. Creosote may be made into a pill with bread-crumbs, and potassium permanganate or nitrate of silver with kaolin.

After being prepared, pills are coated in various ways, but this is purely a pharmaceutical matter. When it is desired that the drug shall act only in the intestine the pill should be coated with salol or keratin.

(4) *Powders*.—Insoluble substances, and those which would be incompatible with each other in fluid form, may be ordered as powders. If only a very small dose of a drug is given—*e.g.*  $\frac{1}{4}$  grain of calomel—the powder should be brought up to a convenient bulk by adding some inert substance such as milk sugar. Small powders may be given dry on the tongue or in a spoonful of milk; otherwise it is well to order them to be dispensed in cachets, which have almost entirely superseded wafer papers.

*Cachets* consist of two watch-glass-shaped pieces of wafer paper, the margins of which cohere on being moistened. They are adapted for insoluble or nauseous powders which it is inadvisable to dispense in fluid form, such as quinine, phenacetin, salacetic acid, salol, saccharated carbonate of iron, etc. They should be moistened before being swallowed.



Quantities up to 20 or even 30 grains of powder can be dispensed in a cachet.

*Tablets.*—Many powders can be conveniently prescribed in tablets, and a number of pharmacists are now able to dispense these according to any desired formula. It should be noted that the word “tabloid” is a proprietary trade name, and if it be used the preparations of the firm which invented it must be supplied. When a prescription is to be made up in tablet form the direction to the dispenser is “Dispense in tablets,” or “Fiat tabella. Mitte tales . . .” Hygroscopic or deliquescent salts should not be prescribed in tablets; the average amount which can be conveniently compounded thus is from 5 to 10 grains.

*Chocolate*, known in pharmacy as *pasta theobromatis*, is, apart from its flavour, a very suitable basis for some tablets. The solvent action of its fats renders it useful for fixing nitroglycerine, menthol, and alkaloids, also for pepsin, santonin, bismuth, and iron (Martindale).

(5) *Capsules.*—Gelatine capsules are now largely used as a means of concealing the taste of unpleasant drugs. They are made to contain amounts up to a drachm, but except for castor oil such large sizes are seldom used. In most cases the dose is 5, 10, or 20 minims. Not all drugs, however, can be dispensed in capsules. Thus any solid which is at all hygroscopic will absorb water from and burst the gelatine covering it. Again, watery fluids cannot be retained in a capsule. When, as is often the case, such nauseous preparations as watery solutions containing viburnum are ordered in this form, the pharmacist has to evaporate the mixture before filling the capsule. This necessitates loss, and enhances the cost considerably. On the other hand, all forms of oil, and drugs insoluble in water may appropriately be prescribed in capsule.

(6) *Granular Effervescent Preparations.*—Several of these are official, but there are in addition a number of salts which may be prescribed in this form. Some of these are—antipyrin, Carlsbad salts, the citrates of caffeine, iron, lithium, magnesium, and others; the salicylates of lithium and sodium, salicylic acid, etc. The dose of all is about a drachm.

(7) *Confections.*—The use of confections is somewhat limited, but they should not be forgotten in prescribing for children. Aperients such as manna and sulphur, hæmatinics such as reduced iron, and other drugs in which a certain laxity of dosage is permissible, may be given with confection of roses or honey.

## II. *By Mucous Membranes in General.*

*A. Throat and Respiratory Tract.*—(1) *Inhalations.*—These are given by adding the desired quantity—about half a drachm—of any volatile drug to a jug of boiling water, and telling the patient to respire the vapour. Special inhalers may also be used. Among the commoner drugs employed in this manner, creosote, carbolic acid, terebene, pine oil, iodine, and friars’ balsam may be enumerated. It is sometimes (*e.g.* in the case of menthol) advisable to use an alcoholic solution of the drug in this way.

(2) *Vapours* constitute another means by which the same end can be attained. A small quantity of a volatile substance, such as crude phenol, is placed in a metal evaporating-dish, and gently warmed by a spirit-lamp or night-light. The vapour is thus allowed to escape continuously into the air of the sickroom. A vaporiser of this description is chiefly used in lung diseases with foetid expectoration, and in whooping-cough.



Similar drugs may be employed at ordinary temperatures by dropping them on a suitable respirator worn by the patient. A method of inhalation by compressed air has been employed in pulmonary phthisis. The patient sits in a cabinet into which air laden with the vapour of creosote is pumped under pressure.

*Fumigations*, or inhalations of medicated smoke, are much used in the treatment of asthma.

(3) *Gargles* are watery solutions of drugs used for the sake of their local action on the throat. The average quantity employed on each occasion is  $\frac{1}{2}$  to 1 ounce. They usually contain alkaline, antiseptic, or astringent drugs, or combinations of these. Rose water may be used as a vehicle to render them more palatable, and some glycerine added to increase their viscosity.

(4) *Sprays* are liquid preparations which are used in an atomiser for application to the upper air passages. The vehicles chosen are usually distilled water, glycerine, oil, or liquid paraffin, while menthol, cocaine, and carbolic acid are among the most common of the active substances selected.

(5) *Insufflations* are medicated powders which are either snuffed up the nostrils or introduced into the mouth, nose, or larynx by means of a suitable insufflator.

(6) *Pigments*.—This name is given to thick liquid preparations which are brushed on the throat. Glycerine is the most common vehicle, but oils and water may also be used.

(7) *Trochisci* and *Pastilles*.—A number of lozenges are officinal; should it be desired to prescribe a drug not included in these in this particular form, it is sufficient to indicate the quantities, and write the direction "*Ft. Trochiscus*." Lozenges are of a hard consistence and dissolve slowly in the mouth. When a softer form is desired, the quantity of fruit paste may be increased, or a pastille may be ordered. The basis of pastilles is a flavoured glycerine-jelly (glyco-gelatin). It will, however, be found that the taste of alkaloids and bitter drugs is scarcely concealed by this basis, though menthol may be made palatable in this form. Glyco-gelatin is incompatible with drugs containing tannic acid.

(8) *Intra-laryngeal and Intra-tracheal Injections*.—This method has been adopted with the object of bringing drugs into direct contact with the respiratory passages and lungs. A special curved syringe is used, and, at least until considerable dexterity is attained, the injection is made with the aid of the laryngoscope. Antiseptic drugs in oily solutions are generally introduced.

*B. Rectum*.—(1) *Enemata*.—Injections into the bowel are given (1) as a means of introducing drugs into the system in unconscious persons or when for any reason stomach or subcutaneous administration is undesirable; (2) to produce a local action; (3) to supply nourishment.

In the case of the first group the enema should be small, not as a rule exceeding two ounces; the dose of the active agent is about double that required when it is given in the usual manner.

Enemata which are designed to act locally are usually given either to evacuate or cleanse the bowel, or to remove flatus, to act as sedatives or astringents and check diarrhoea, or to destroy parasites. Evacuant enemata are large, and consist of water or soap and water in which olive oil, castor oil, or turpentine may be suspended. Sedative enemata should not exceed one or two ounces; they may consist of thin starch, gelatine, or



mucilage containing half a drachm of laudanum. Large injections of astringents are sometimes used in cholera and diarrhoeal diseases generally. As it is desired that these should be retained as long as possible, they should be injected very slowly and steadily, the buttocks of the patient being raised so that the fluid may gravitate into the colon. Anthelmintic enemata may measure about half a pint for an adult; the preparations most frequently employed are salt (2 drs. to 10 ozs.), infusion of quassia, tincture of perchloride of iron (1 dr. to 10 ozs.), or thymol.

(2) *Suppositories*.—The best basis for these is cacao butter, with which the drugs to be administered are to be incorporated. Glycerine jelly may also be used. The irritation it produces depends on the proportion of glycerine it contains; gelatin lessens this, or a sufficient quantity of water annuls it completely.

Attempts have been made to utilise the rectal mucosa as a channel for the absorption of various drugs in gaseous form—*e.g.* chloroform vapour, ether vapour, hydrogen sulphide, carbonic acid, etc.—but these have not met with any degree of success.

*C. Genital and other Mucous Membranes*.—In this case drugs are used for their local action only, though it must be remembered that certain general effects may ensue. Thus development of the drug-habit following the prolonged use of strong cocaine ointment for intractable pruritus has been observed.

In these regions the drugs employed are generally introduced in the form of watery injections, pigments, pessaries, or bougies. *Pessaries* are prepared with a basis of glycerine jelly where a hygroscopic effect is desired, or of cacao butter. *Pigments* may either be applied with a brush or swab, or on tampons of wool which are allowed to remain *in situ*. *Urethral bougies* are made with a gelatin or cacao butter basis.

*Nasal* and *aural* bougies and suppositories, of similar composition, are also occasionally prescribed.

### III. *By the Cutaneous Surface.*

In the majority of cases drugs are applied to the skin with the object of treating some cutaneous disease by local action. Before considering the different modes by which this can be carried out, one or two methods which do not fall into the above category may be mentioned.

*Counter-irritants* are generally employed in order to influence some deeply seated organ. Of those in common use, the principal, arranged in order of increasing potency, are mustard, turpentine, liniment of ammonia, tincture and liniment of iodine, croton liniment, and cantharides preparations. The milder liniments should be rubbed on with the hand; iodine and croton liniment should be painted on with a brush. The last is somewhat uncertain in its action; it should in the first instance be diluted with an equal bulk of olive oil or soap liniment, and should never be applied to exposed parts of the skin, as it may cause scarring. Cantharides may be ordered as the plaster, to be applied at night and kept on for six or eight hours, and followed by a linseed poultice if need be. The liquor epispasticus may also be used. Great care ought always to be taken in the use of strong counter-irritants in children, since in conditions of debility, such as follow acute diseases, particularly measles, sloughing of the skin readily takes place.

More powerful than any of the preceding are *Escharotics* such as lunar caustic, strong nitric acid, caustic potash, etc.



The skin is rarely used as a channel for the administration of drugs intended to act generally. Watery solutions penetrate its horny layer with great difficulty, unless carried in by the galvanic current—a method of medication which, after falling into almost complete desuetude, has recently been revived with considerable success as a means of obtaining a more or less local action—*Electrolysis* or *Cataphoresis*. Only electrolytic solutions can be employed in this way; drugs which do not ionise cannot be introduced into the body by electrolysis. Salts in solution dissociate into an electro-positive metallic ion (kation) and an electro-negative acid radicle ion (anion) (*vide* CATAPHORESIS; IONIC MEDICATION IN GYNECOLOGY). When a current is passed through such a solution the kations descend, the anions ascend, the current. The human body is an electrolyte, and if an electrolytic solution be used at the electrodes of a battery connected with the body the descending kations will penetrate the skin at the positive pole; the ascending anions will enter at the negative pole. This can be shown experimentally in animals: strychnine salts cause poisoning when applied at the positive, but not at the negative electrode, the kation here being the active ion; with potassium cyanide the reverse is the case, the anion being toxic. The rule therefore is, to use the positive pole when the action of the metallic ion is desired, the negative pole for the acid radicle. As examples we may mention the use of zinc chloride at the anode for rodent ulcer; salicylate of soda at the cathode for chronic rheumatism. In the one case the zinc, in the other the salicylic ion, acts locally. The solutions are applied on layers of lint connected with the electrode; the other electrode is placed on some indifferent part of the body. A current of 30 or 50 ma. more or less is used. (Dawson Turner, *Edin. Med. Journ.*, N. S. xxiii. 1908.)

Apart from this, if the absorption of a drug through the skin is desired, it must be applied in the form of an ointment. *Fumigation*, as a means of attaining the same end, has fallen into almost complete disuse, and the possibility of a powder being absorbed by the sebaceous and other glands is not made use of in practice. The same remark applies to the *Endermic method*, in which powdered drugs were applied to and absorbed from the raw surface left by a rapidly acting vesicant, such as strong ammonia or chloroform.

In fact, the chief drug which is now administered by the skin is mercury in the inunction treatment of syphilis. The blue ointment is thoroughly rubbed into the skin, or spread on a binder which is kept applied over a considerable area. More recently the cleaner practice of wearing a bib impregnated with mercury has been introduced. Another drug which is sometimes given by this channel is guaiacol, which is a powerful depressant and antipyretic when applied to the skin in fever.

*Local Applications to the Skin.*—(1) *Ointments.*—The most common bases are lard, vaseline, lanoline, wax, and cetaceum. *Lanoline* (hydrous wool fat, *adeps lanæ hydrosus*) is readily miscible with water, and in its anhydrous form is distinctly hygroscopic and may therefore irritate. It is somewhat tough, and may be made more workable by the addition of olive oil or vaseline. *Vaseline* is believed to give up incorporated drugs more readily than the others, hence yields a more active ointment. *Oleic acid* is chiefly used for preparing alkaloidal ointments.

*Cold creams*, or ointments containing a considerable quantity of water, have a refrigerant effect—an instance is the unguentum aquæ rosæ of the Pharmacopœia.



When a large proportion of powder is incorporated with a fatty basis a *Paste* results—as in the case of the well-known Lassar's paste, which consists of equal parts of zinc oxide, powdered starch, lanoline, and vaseline. Pastes differ from ointments in being less penetrating, and in permitting excretions to escape more freely.

*Salves* are ointments medicated in various ways, and spread on muslin. Sometimes the muslin is made impermeable (and the salve more active) by being coated with gutta-percha.

(2) *Plasters*, with one or two exceptions, such as the emplastrum belladonnæ, are not much used. They consist of an adhesive basis, to which drugs are added, spread on leather or linen. Among the best known are the salicylic acid and creosote plaster used in the treatment of lupus; emplastrum hydrargyri, sometimes used for dressing syphilitic ulcers; and the emplastrum plumbi, with which chronic inflammatory conditions are occasionally strapped. The last is a useful plaster basis, to which other drugs may be added.

(3) *Varnishes*.—These are preparations which, when applied to the skin, evaporate and leave a thin adherent coating. They may be medicated in various ways. Among the most generally employed are the linimentum exsiccans (tragacanth 5, glycerine 5, water 100); glyco-gelatine, or glycerine jelly, which requires to be melted before being applied; collodion; and traumaticin (gutta-percha 1 dr., chloroform 1 oz.). Alkalies should not be added to preparations containing mucilage. Fats can be incorporated with solutions of glycerine. Collodion is chiefly used as a vehicle for salicylic acid, and traumaticin for chrysarobin. Ichthyol, sulphur, zinc oxide, etc., may be added to the gelatine preparations.

(4) *Dusting Powders* may be applied by dredging, or by laying a muslin bag containing them over the affected part. They act as sedatives to inflamed cutaneous surfaces, and absorb secretion. The substances most commonly used are starch, zinc oxide, boric acid, talc, fuller's earth, kaolin, and carbonate of magnesia. Boric acid alone is irritating, and should be diluted with starch.

(5) *Lotions*.—The basis of lotions is water, to which rectified spirit, glycerine, mucilage, and occasionally oil, may be added. The first of these, by its evaporation, imparts a cooling character to the lotion; glycerine and mucilage are added in order to suspend powders. It should be remembered that some skins do not stand glycerine well on account of its hygroscopic properties.

(6) *Liniments* are generally used as counter-irritants; occasionally as sedatives. They are usually solutions or emulsions of drugs in oils, soaps, or alcohol. Oils and fats penetrate the skin with difficulty; this is diminished by the addition of alcohol or acetic acid. Soap and yolk of egg are commonly employed as emulsifying agents.

(7) *Baths*.—These may be simply sedative, when such substances as starch (1 to 2 lbs.), bran (2 to 5 lbs.), or gelatine are added to 25 or 30 gallons of warm water. Again, they may be medicated by the addition of alkalies, such as carbonate of soda (2 to 10 ozs.), potassium sulphide (2 to 4 ozs.), or tar. Mustard baths (1 oz. to 1 gallon) are very powerful stimulants; the patient is held in the bath until the arms of the attendant begin to tingle.

(8) *Soaps*.—These are not much used for the application of drugs to the skin. The intensity of their action is increased if the lather is allowed to dry on, and still more if it is thoroughly rubbed in until



dry. One of the most valuable soap preparations is *Hebra's soap spirit*, consisting of two parts of potash soap to one part of rectified spirit, which is of great use in the treatment of seborrhœa of the scalp.

In ordering soaps the chief points to be borne in mind are, that when a decided detergent effect is desired, an alkaline soap should be selected; when all irritation must be avoided, an over-fatty one. It is, however, to be remembered that much of the irritation which some soaps cause is due less to their alkalinity than to the rosin and fats used in their manufacture.

#### IV. *Injection through the Skin.*

(1) *Hypodermic Injection.*—The conveniences of this mode of administering active drugs are many and obvious: the medicine acts rapidly and certainly, it does not derange the digestion, and it can be given to an unconscious or rebellious patient. The introduction of the tablet form of drug for hypodermic medication renders an error in dosage practically impossible, and minimises risk of sepsis; it also renders unnecessary the addition of any preservative to a solution for hypodermic injection. Vaccines consisting of dead bacteria, solutions of tuberculin, etc., should be preserved in sterilised bottles closed by sterile rubber caps, through which the hypodermic needle is thrust to withdraw the requisite dose. Some hypodermic preparations—*e.g.* ergot, adrenaline—may be conveniently preserved in hermetically sealed glass capsules, each containing a single dose. Provided the needle is kept clean there is very little risk of suppuration, but it is safer to use a syringe and needle which have been boiled before use. In giving the injection, a fold of skin is pinched up and the needle introduced through the whole thickness of the true skin, so that the fluid can be painlessly injected into the loose subjacent cellular tissue. If the needle does not penetrate sufficiently, and the fluid is injected into the deeper layer of the epidermis, some pain will be caused. After the needle is withdrawn the part ought to be gently rubbed to promote absorption of the fluid. It should be remembered that a hypodermic injection of ether is much more painful than one of an ordinary alkaloidal solution, and that, particularly when the vitality of the patient is low, a superficial slough may occur.

In giving a subcutaneous injection, the neighbourhood of large veins and nerve trunks should be avoided. When, however, local anæsthesia over a considerable area is aimed at, drugs such as cocaine or morphia are sometimes injected near to, or actually into the sheath of, a nerve trunk.

(2) *Intramuscular Injections.*—These are employed chiefly in the administration of drugs such as ergot, which are reputed to be liable to cause an abscess, or which, like calomel or mercury in oily suspension, are intended to be very slowly absorbed. Muscles of coarse fibre, such as the glutei, should be selected as the point of injection.

(3) *Intravenous Injection.*—This mode of administration, on account of the obvious risks attending it, has never enjoyed a great vogue. Drugs introduced into veins act much more rapidly than when injected under the skin. The principal applications of intravenous injection are for the introduction of saline solution to cope with sudden collapse, and of alkalies in diabetic coma and acidosis generally. Among special uses of this method, the injection of mercury in syphilis, of formalin in



septicæmia, and of iodoform and other antiseptics in phthisis may be mentioned.

(4) *Injection into the Subcutaneous Tissue (Hypodermatoclysis).*—Here also, saline solution is the agent chiefly employed. The fluid may be introduced at almost any part of the body, but sites where the skin is loose and cellular tissue abundant—*e.g.* the mammary region—are to be preferred. A fairly large needle, or a number of needles, should be employed, and the fluid, amounting to one or two pints, allowed to flow in by gravity. The vessel containing it may be attached to the patient's bed about eighteen inches or two feet above the point of injection. Care should be taken to maintain the fluid at a temperature of about 100°. In selecting a site for the injection, one which will interfere with any surgical procedure which may afterwards be necessary should of course be avoided.

Injections of saline solution into the retro-rectal connective tissue have been advised for incontinence of urine. The needle, guided by a finger in the rectum, enters near the tip of the coccyx and is carefully passed up behind the bowel. About a hundred cubic centimetres of fluid may be injected in this way.

The injection of paraffin into the subcutaneous tissue for cosmetic and other purposes does not fall within the scope of this article.

(5) *Intra-spinal Injections.*—Of late years these have been somewhat extensively used, particularly for the induction of cocaine or stovaine anæsthesia below the level of introduction. The strictest antiseptic precautions are naturally essential. A syringe with a needle four or five inches long, which can be boiled, should be used. The patient is placed with the thighs flexed on the abdomen, and the point of the needle is introduced between the third and fourth lumbar vertebræ (just above a line joining the highest points of the iliac crests) about half an inch to one side of the middle line. The needle is thrust steadily in, in a slightly oblique direction upwards and inwards, its point being withdrawn if it catches against the arch of a vertebra. When the needle reaches the spinal canal a few drops of cerebro-spinal fluid flow out; the escape of blood shows that a vein has been punctured. When the needle is in the canal the syringe is attached, and the fluid slowly injected. Some advise that before the solution is introduced an equivalent quantity of cerebro-spinal fluid should be allowed to drain away. When cocaine is the drug selected the patient's head and shoulders should be raised after the injection, so as to prevent the fluid from passing up the spinal canal. After giving intra-spinal injections of collargol for cerebro-spinal fever traces of the drug can be found at the base of the brain two days after the drug was injected. Evidently, therefore, substances introduced by lumbar puncture may affect the cranial as well as the spinal contents.

(6) *Epidural Injections* have recently been highly recommended as a means of treating enuresis nocturna. Saline solution is the drug employed. The needle is introduced at an angle of 60° to the skin, just above the middle of the line joining the cornua coccygea of the sacrum. When the resistance of the anterior wall of the sacral canal is felt the needle is inclined parallel with the skin and passed up the sacral canal. From 10 to 40 c.c. of saline solution may be injected. The dura should not be punctured.

*Intra-cerebral injections* have been used in the treatment of tetanus



by the antitoxin, with the object of introducing the serum into the immediate neighbourhood of the poisoned nerve centres.

(7) *Intra-Pulmonary Injections*.—The direct introduction of anti-septics into the diseased lung by means of an ordinary exploring needle has been tried, but is neither free from danger nor attended by decided benefit.

*Extra-Pharmacopœial and other New Drugs.*

In addition to the drugs which find a place in the Pharmacopœia, new remedies are constantly being introduced. For information concerning these, two standard authorities, Martindale and Westcott's *Extra-Pharmacopœia* and the *British Pharmaceutical Codex*, should be referred to. Besides giving a great deal of pharmaceutical information, both volumes contain a number of useful formulæ, many of which are modelled on those of remedies which have gained popularity under various commercial names. As well as giving these formulæ, the compilers of the Codex have introduced brief descriptive names for a variety of substances of definite composition which are already known under special names. Many of these special names are trade protected and can only be legally applied to the products of firms or individuals in whom proprietary rights in these names are vested. Everyone, of course, may produce the drugs under the Codex name, but when the proprietary name is used only the product of the firm which has a legal right to the name can be dispensed.

The advantages of prescribing under the Codex names are: (1) the encouragement of "free trade" in the manufacture of drugs; (2) in many cases, the concealment from a patient of the nature of the remedy; and (3) economy. To give an instance: a certain fashionable drug sells wholesale under its original (trade) name at 1s. 4d. per ounce; the same drug can be supplied, if ordered under its Codex name, at a quarter of the sum. On the other hand, by ordering a drug under its trade name we have such guarantee of its quality as the reputation of its maker affords.

The following list, which is not exhaustive, giving the synonyms of some of the chief commercial products now made, has been compiled from the *Codex*, 1907:—

Trade Name.	B.P.C. Name.	Trade Name.	B.P.C. Name.
Acetysal	Aceto-salicylic acid	Anodynin	Antipyrine
Actol	Silver lactate	Antikamnia	Chiefly acetanilide
Adnephrine	Adrenine	Antisepsine	" "
Adren	"	Antitoxine	" "
Adrenaline	"	Argonin	Silver caseinate
Airoform	Bismuth oxyiodo-gallate	Argyrol	Silver vitellin
Airogen		Aristol	Thymol di-iodide
Airol		Arrhenal	Sodium metarsenate
Albolene	Liquid paraffin	Aspirin	Aceto-salicylic acid
Aletodin	Aceto-salicylic acid	Atoxyl	Sodium anil-arsenate
Ammonol	Chiefly acetanilide	Benzosol	Guaiacol benzoate
Analgen	Quinalgen	Betol	Naphthol salicylate
Analgesine	Antipyrine	Bromo-acetanilide	Chiefly acetanilide



Trade Name.	B.P.C. Name.	Trade Name.	B.P.C. Name.
Calcinol	Calcium iodate	New uro-	Formamol
Castor oil	Magnesium ricin-	tropin	
powders	oleate	Nosophen	Iodophenophthalein
Chloretone	Chlorbutol	Novargan	Silver proteinate
Citramine	Formamol	Ol. deelinæ	Liquid paraffin
Collargol	Silver colloid	Paranephrin	Adrenine
Creosotal	Creosote carbonate	Parolein	Liquid paraffin
Cystamine	Formamine	Phenalgin	Chiefly acetanilide
Cystogen	"	Pinol	Oil of pine
Dermatol	Bismuth subgallate	Proponal	Homalurea
Dionin	Ethyl morphine hyd.	Protargol	Silver proteinate
Diuretin	Theobromin-sodium	Pumiline	Oil of pine
	salicylate	Purgen	Phenophthalein
Duotal	Guaiacol carbonate	Pyraloxin	Oxidised pyrogallic
Eucaïne	Betacaine hydro-		acid
	chlor.	Renaglandin	Adrenin
Euquinine	Quinine ethyl car-	Renostyp-	"
	bonate	ticin	
Europfen	Butyl cresyl iodide	Salazolone	} Antipyrin salicy-
Exalgin	Methyl acetanilide	Salipyraxolon	
Formin	Formamine	Salipyrin	late
Hæmostasine	Adrenine	Saletin	Aceto-salicylic acid
Helmitol	Formamol	Soluroi	Thymic acid
Hemisine	Adrenine	Styracol	Guaiacol cinnamate
Heroin	Acetomorphine	Suprarenaline	Adrenine
Ichthalbin	Albumin ichthyo-	Suprarenin	"
	sulphonate	Tannalbin	Tannin albumin
Ichthargan	Silver ichthyosul-	Tannigen	Acetannin
	phonate	Tannocol	Tanno gelatin
Ichthoform	Formaldehyde ich-	Tannoform	Methyl ditannin
	thyosulphonate	Tetronal	Eythl sulphonat
Iodol	Iodopyrrhol	Trional	Methyl "
Itrol	Silver citrate	Uretone	Formamine
Kelene	Ethyl chloride	Urisol	"
Largin	Silver albuminate	Urophenol	Formamol
Laxatin	Phenophthalein	Urotropin	Formamine
Laxoin	"	Vasocon-	Adrenine
Levuretime	Zymin	strictine	
Levurine	"	Veronal	Malourea
Neurotropine	Formamol	Xaxa	Aceto-salicylic acid

**Protozoa.**—During late years our knowledge concerning the pathogenicity of the protozoa has received many additions, and we have now to recognise in many of these organisms infective agents second in importance only to the bacteria. They are higher life forms than the bacteria, and while no hard-and-fast line can be drawn between the two, the following characteristics serve generally to distinguish the protozoa. The protozoa are unicellular organisms endowed usually with organs for locomotion as well as for the capture, devouring, and digestion of food. Their bodies have either no cuticle, or, if there be one, it is rarely of cellulose; they invariably contain nuclear material.



Reproduction takes place by cell division, which is in most cases supplemented by some form of conjugation. This alternation of asexual and sexual phases is one of the chief characters distinguishing the protozoa from lower forms; it is the feature, also, which renders their study so difficult, because the different phases of an organism are often so dissimilar as for long to escape identification. Reproduction may take place by (1) *simple fission*, resulting either in the formation of two symmetrical organisms (binary fission); by (2) asymmetrical fission—*budding*, or *gemmation*; or by (3) multiple fission—sporulation—in which the nucleus breaks up simultaneously, or divides successively, into a number of individuals. This asexual generation may go on for many generations, but cannot continue indefinitely. Like the metazoa, the protozoa ultimately become senescent and die, unless rejuvenation takes place by sexual conjugation. Such weakening with age has been experimentally demonstrated in the paramœcium, by isolating the individuals as they are reproduced by fission, and thus eliminating sexual conjugation. After a number of generations unmistakable signs of old age appear, and the race dies out. Sexual reproduction (*zygosis*) may occur at different points in the life cycles of different forms; it consists in the fusion of the nuclei of two individuals (*gametes*), which may be either young individuals or adults, and may be similar or dissimilar. Nuclei which are about to conjugate are called *pronuclei*; the nucleus which is formed is a *synkaryon*, and the new individual, a *zygote*. Gametes probably always undergo a process of maturation, with extrusion of polar bodies, before zygosis takes place. In the case of union of dissimilar gametes (*anisogamy*) one is usually smaller and more motile, the other larger, and full of reserve material; the former is regarded as the male, the latter as the female, partner. Not only may the gametes differ from one another, but the generation (*gametocytes*) which produces the gametes may be differentiated from the ordinary members of the species. Thus a species may be highly polymorphic with a recurrent cycle of different forms: ordinary asexual or vegetative cycle, and gametocytes, gametes, male and female of the sexual cycle. Under special circumstances a sexual individual may revert to asexual reproduction (*parthenogenesis*).

Protozoa are divided into four classes—sarcodina, mastigophora, sporozoa, and infusoria.

I. SARCODINA.—This group includes the *amœbæ*, some of which (*e.g.* *amœba coli*) are pathogenic to man. The cytoplasm has no envelope, and movements for the capture of food are effected by pseudopodia. Reproduction takes place by simple fission, the latter being associated with some form of zygosis. There are three parasitic species of amœbæ—*entamœbæ buccalis*, *entamœbæ coli*, and *entamœbæ histolytica* (Schaudinn). Schaudinn proved that the amœba of dysentery was not identical with the amœba coli. The organisms differ in their life histories, and the spores of amœba dysenteriae (*histolytica*) are infective to cats.

II. MASTIGOPHORA.—This group consists of protozoa with flagellæ. It is a large group, with many subdivisions, of which the Trypanosomatidæ are by far the most important from a medical standpoint.

The Trypanosomatidæ include various genera, all having as a common feature the possession of an undulatory membrane. They exist as parasites in the fluids of the body, not in the cells. A typical trypanosome has a spindle-shaped body with a more or less centrally-placed macronucleus, and a micronucleus near one extremity. The body is furnished



with an undulatory membrane, and a single flagella which originates near the micronucleus and runs along the edge of the undulatory membrane, from the extremity of which it is prolonged. The same general description applies to the trypanoplasma (which is parasitic in the blood of fishes), but the latter has in addition a second flagella, also arising near the micronucleus, but emerging directly from the body without being attached to the undulatory membrane. The trypanosomes are purely blood parasites of the vertebrata, but have the power of passing into the lymph and other tissue fluids.

Among pathogenic trypanosomes, *T. Brucei*, the cause of nagana or tsetse-fly disease of horses and cattle in Africa, *T. equiperdum*, the cause of dourine in horses, *T. equina*, the cause of mal de caderas in horses, and *T. Evansi*, the cause of surra in horses, may be mentioned. Far more important than these, however, is the *T. gambiense*, the parasite of sleeping sickness (*q.v.*) in man. A number of harmless parasitic trypanosomes are also known—e.g. *T. Lewisi*, in the rat.

All species of trypanosome, except *T. equiperdum*, have an intermediate invertebrate host. *T. equiperdum* is transmitted directly by coitus. In all cases studied the sexual cycle takes place in the invertebrate host. The general life cycle is as follows:—Indifferent, and sexually differentiated male and female individuals can be recognised in the blood of the vertebrate host, but complete differentiation takes place only in the invertebrate. All types may multiply by simple fission. The females are the most resistant forms, and if by chance the males and the undifferentiated forms perish, parthenogenesis occurs and the host is repeopled. Zygosis is preceded by maturation of the nuclei. The zygote is a simple organism which develops micronucleus, flagella, and undulatory membrane and becomes an ordinary trypanosome which begins a new vegetative cycle. In one species, according to Schaudinn, an intracellular stage of development occurs. The *trypanosoma noctuæ*, of the owl, the general cycle of which resembles the above, after entering the blood of the vertebrate host penetrates the blood corpuscles during the day, loses its power of locomotion, and changes into the parasite which has long been known as the *Halteridium Danilewskii* (see *Encyclopædia Medica*, Vol. IX. p. 203). During the night it escapes from the corpuscle, resumes its trypanosome shape, and is found chiefly in the internal organs. The entire cycle takes from six to eight days.

*Spirochætes*.—The genus *spirochæta*, often confused with the spirilla, are possibly allied to the trypanosomes, but great uncertainty exists as to their zoological position. A number of parasitic spirochætes have been described—*s. refringens*, *s. plicatalis*, and, in particular, *s. pallida*, the causal agent of syphilis (*q.v.*). There is also a *s. pertenosis* (Castellani), believed to be the cause of yaws. The organism of relapsing fever (*spirillum obermeieri*) is now generally regarded as a spirochæte, and Dutton and Todd found a similar, though not identical organism (*s. Duttoni*) in the relapsing or tick fever of the Congo. In connection with the relation of the spirochætes to the trypanosomes it is of interest to refer to Mott's observations on the morbid anatomy of the nervous system in sleeping sickness and general paralysis. The lesions are identical; in the one case the disease is assuredly due to a trypanosome, in the other almost certainly due to a spirochæte. The spirochætes are flexible spiral organisms with an undulatory membrane but no flagellæ. The *s. pallida* is described in the article SYPHILIS.



*Leishman-Donovan Bodies*.—These bodies, now recognised as the cause of kala-azar (*q.v.*), probably fall into the same group of organisms, though there is considerable doubt as to their exact position. They were originally regarded as a species of trypanosome, Donovan and Laveran thought they belonged to the group piroplasma, Ross regarded them as a new form of sporozoa, and Rogers states that the late Professor Schaudinn, shortly before his death, took them for a new species of flagellata, for which he proposed the name "*Leishmania-Donovani*." Rogers succeeded in cultivating them outside the body, and found that they underwent changes which led to the appearance of herpetomonas-like forms. In a recent communication (*Lancet*, 30th Jan. 1909) W. S. Patton states that they belong to the genus *Herpetomonas*, the type of which is *H. muscæ domesticæ*. His description of the life cycle of the parasite of kala-azar in the bed-bug closely resembles that of the fly herpetomonas. The cycle of *H. muscæ domesticæ* consists of a pre-flagellar stage, in which the round or oval organisms multiply by fission or segmentation. Each organism so formed develops a flagella, becomes elongated, and divides longitudinally. After this the organisms become rounded and lose flagellæ (post-flagellar stage), and are shed in the excreta of the fly. They are again sucked up by flies while feeding. The whole cycle occurs in the fly. Patton supposes that the parasite of kala-azar passes through its pre-flagellar stage in man, and completes its cycle in the bed-bug. He proposes to call the group of diseases produced by these organisms the Herpetomoniasis—*Herpetomonas Donovanii* causing kala-azar; *H. infantum* the parasite of infantile splenomegaly (Nicolle); *H. tropica*, the parasite of oriental boil (Wright).

III. SPOROZOA.—This group of organisms have no organs of locomotion or organs for the capture of food. Reproduction is by sporulation. They are parasites—cytozoic, or intracellular (including hæmatozoic), cœlozoic, or in the body cavities, or histozoic, in the tissues, generally between the cells. The chief pathogenic sporozoa are: 1. Coccidiidea; 2. Hæmosporidia; 3. Sarcosporidea; 4. Haplosporidea; 5. Cytoryctes.

The Hæmosporidia include the plasmodium malariae; the hæmogregarina, common in cold-blooded vertebrates, and lately described in a warm-blooded vertebrate (*H. Balfouri* of the jerboa); the halteridium (mentioned above as probably a trypanosome); and the piroplasma.

*Piroplasma* is a parasite of mammals, the invertebrate host being the tick. It causes a group of diseases known as piroplasmoses, of which hæmoglobinuria is the leading symptom. The best known species is one which infests cattle. One form (*P. hominis*) is alleged to be the cause of the "tick fever" of the Rocky Mountains.

One member of the *Haplosporidia*—Rhinosporidia Kinealyi—has been found in vascular pedunculated tumours of the nasal septum in Indians.

*Cytoryctes*.—This subgroup comprises a series of intracellular parasites found in various infectious diseases and considered by some to be the causal agents. *Cytoryctes variolæ*, *cytoryctes vacciniæ*, *cytoryctes aphtharum* (foot-and-mouth disease), *cytoryctes scarlatinæ*, and *cytoryctes luis* (Siegel's parasite of syphilis) have been described.

*Cytoryctes variolæ et vacciniæ*.—Councilman and Calkins's recent work on the cytoryctes leads them to suppose that the organisms of variola and vaccinia are identical. In variola the cytoryctes passes through two phases—an asexual, during which it inhabits the cytoplasm of the stratified epithelium of the skin, and a sexual, which takes place in the



nuclei of the cells. In vaccinia only the former, asexual, cycle occurs. Councilman and Calkins postulate a further, hypothetical, stage during which minute spores travel throughout the body from the seat of primary infection. Calkins (cited in Osler's *System of Medicine*, vol. ii. p. 259) gives the life history as follows:—"The first development of the germ in the host is unknown. It probably takes place in the seat of primary infection, forming an organism which reproduces by germs." These are probably carried to the skin in the blood, and from this point the observations are fairly complete. "The gemmules become cytoplasmic amoeboid organisms which give rise to similar gemmules. This process, which Councilman has designated the 'vaccine cycle,' must continue for some time, for in variola the gemmules are distributed to all parts of the skin. Ultimately the germs derived in this way give rise to forms which penetrate the nuclear membrane and develop into gametocytes of two types, one forming the supposed male gametes, the other the female." From the conjugation of these gametes a zygote forms from which in turn spores develop. The spores infect other nuclei, perhaps spread widely throughout the body, and may transmit the disease to other parts.

**Psoriasis.**—The eruption of psoriasis often persists on the elbows and knees after it has been cured elsewhere. Such chronic spots are often very rebellious to treatment. In these cases a good application is an ointment introduced by Dreuw and consisting of—ac. salicyl., 10 parts; chrysarobin and ol. rusci (birch-tar), āā 20 parts; sapon. virid. and vaseline, āā 25 parts. This is to be well rubbed in morning and evening for four to six days, and then vaseline applied for two to three days. The treatment is repeated as often as necessary till the spots have all disappeared. The salicylic acid and green soap are very effectual in removing the scales and allowing the chrysarobin and tar to act on the lesion. Like all chrysarobin ointments, it has the disadvantage of staining the clothes.

Another drug which has been much employed in those inveterate spots of psoriasis is eugallol, which is pyrogallol-mono-acetate. Like ordinary pyrogallic acid, it is a reducing agent. It is most easily applied dissolved in an equal bulk of acetone, forming, when painted on the skin with a brush, a firm varnish. This same application is also useful in chronic patches of scaly eczema.

X-rays will also cause the disappearance of psoriasis spots, leaving a marked pigmentation; but as the "cure" in such cases is not any more prolonged than after other less dangerous applications, it is not a method to be generally recommended.

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**Puerperium, Management of.**—Allusion has already been made to the criticism to which the practice of binding the abdomen in the puerperium has been recently subjected, as well as to the almost universal abandonment of routine vaginal douching of the puerperal patient (see LABOUR, MANAGEMENT OF); but of late years a very important modification of the management of the lying-in period has



been suggested and practised to some extent, viz. permitting the patient to rise much earlier in the puerperium than had previously been customary.

In 1899 Küstner (*Zentralb. f. Gynäk.*, xxiii. p. 705, 1899) raised the question of prolonged rest for women in the puerperium at the meeting of the German Society for Gynecology in Berlin. He thought that for strong, healthy puerperal patients who had come through a normal labour, and had neither been infected nor had suffered lacerations, a rest in bed for several weeks was not only needless but actually harmful; they ought to rise on the third, fourth, or even on the second day after delivery. If, however, there had been lacerations (vestibular, perineal, vaginal, or cervical), if the patient had entered the clinique showing signs of infection, if she had a profuse gonorrhœal discharge, if operative means had been employed in the delivery, or if the labour, although terminated by nature, had been tedious, the longer rest in bed should be permitted. Küstner reported that patients thus treated did not suffer in any way: they did not develop prolapse or retroversion of the uterus, the involution of that organ was not delayed but hastened, the functions of the digestive tract were greatly improved (good appetite, natural action of the bowels), and there was no difficulty with micturition, which occurred spontaneously and more frequently. In the discussion which followed the hearing of Küstner's experiences fears were expressed by Olshausen and others lest the involution of the supporting ligaments of the uterus might be interfered with, lest the abdominal walls might remain relaxed, lest thrombosis might be more frequent, and lest the pelvic musculature might suffer. At first Küstner's new method of treatment, breaking, as it did, through a practice so firmly established as rest in bed during the puerperium, met with little support; indeed, in many parts of the world it was not even discussed. Of late years, however, it has found advocates in various places, and has consequently excited animated controversy. Reference may be made to the following articles which have recently appeared:—Edmonds (*Mass. Med. Journ.*, xxvi. p. 351, 1906); Pierra (*Rev. prat. de gynéc., d'obstét. et de pédiat.*, ii. p. 340, 1907); Wallich (*Rev. prat. d'obstét. et de pædiat.*, xx. p. 129, 1907); Bouchacourt (*Presse méd.*, xv. pp. 307, 410, 1907); Heil (*Arch. f. Gynaek.*, lxxxi. p. 95, 1907); E. Martin (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 248, 1908); Von Winckel (*Deutsche med. Wochensch.*, xxxiv. p. 49, 1908); Brisset (*Union méd. du Canada*, xxxvii. p. 200, 1908); Rosenfeld (*Gynaek. Rundschau*, ii. p. 401, 1908); von Alvensleben (*Zentralb. f. Gynäk.*, xxxii. p. 1184, 1908); Hinchey (*Interstate Med. Journ.* (St. Louis), xvi. p. 26, 1909); Gellhorn (*ibid.*, p. 33, 1909); K. Mayer (*Münch. med. Wochensch.*, lvi. p. 273, 1909); Simon (*ibid.*, p. 47, 1909); Fromme (*Zentralb. f. Gynäk.*, xxxiii. p. 15, 1909); Hofmeier (*ibid.*, p. 21, 1909); E. Opitz (*Med. Klin.*, v. pp. 5, 48, 1909); Fehling (*Strassb. med. Ztg.*, vi. p. 14, 1909); and Haultain (*Brit. Med. Journ.*, ii. for 1909, p. 307).

So far nearly all the records have been favourable, and seem to show that after normal labours there is no need for prolonged rest in the horizontal posture. Karl Mayer allowed his patients to rise when they liked, with the result that 4 rose on the third day, 40 on the fourth, and 100 on the fifth day; the morbidity was lower by 10 per cent. than among those who followed the old-established rule. Von Alvensleben found that out of one hundred cases 3 rose on the first day, 61 on the second, 19 on the third, and 18 on the fourth; the morbidity was less amongst them than that of the general clinique (10 per cent. in the one



case, 17 per cent. in the other). Dealing with 235 parturients, Opitz found that 56 got up on the first day, 65 on the second, 27 on the third, 52 from the fourth to the sixth day, 21 on the seventh and eighth days, and 14 later; his results showed that retroflexion of the uterus was not made more likely by the early rising, that involution was satisfactory, and that convalescence was not interrupted. Opitz, however, admitted that it was difficult to prevent the newly-delivered woman leaving the hospital too soon, and referred to the fact that in private practice there might be danger owing to the puerperal patient being under less constant observation. Krönig (*Deutsche med. Wochensch.*, xxxiii. p. 1528, 1907) does not seem to have been influenced by this fear, for 70 per cent. of his private patients (250 in number) got up during the first day; he also still further shortened the resting period for patients delivered under the influence of scopolamine and morphine injections, allowing a certain number to get up from eight to ten hours *post partum*. His published results have been very good, and he did not meet with any cases of thrombosis or embolism; he was of opinion that his patients were better able to nurse their babies, that uterine involution went on quite as well, that the lochia came away more readily, that there was less risk of accumulation of fæces in the rectum, that the appetite was better, and that, speaking generally, the bodily system was better able to resist infection. Rosenfeld (*loc. cit.*) also was able to report good results, but he restricted his patients to rising for one hour on the third or fourth day; the time was gradually increased till they left the hospital on the eighth or tenth day. Somewhat similar was Simon's plan (*loc. cit.*); he kept his patients in bed for three days, allowed them to get up to pass water, if there was any difficulty with micturition; they got up for an hour on the fourth day, and for two hours on the fifth, if there was no fever; he insisted on the wearing of a binder, and instituted gymnastic exercises to strengthen the abdominal muscles (bending and rotating the trunk, etc.); and he believed that his patients made better recoveries. In America Hinchey (*loc. cit.*) wrote in favour of early rising in the puerperium, whilst Gellhorn was of an opposite opinion (*loc. cit.*). The latter cited the observations of Müllerheim on more than a thousand women in Berlin, many of whom, although they were all discharged from the hospital as being in perfect condition, required weeks of rest and treatment for disturbances coming on after their return home. He also referred to the frequency of embolism and prolapsus uteri among Javanese women (as noted by Wagener and himself), and pointed out that, by an old law, these women were compelled to get up immediately after confinement and walk about, but not to attend to their domestic duties. A still more serious criticism of the early-rising régime is contained in the occurrence of a death from thrombosis and embolism in the case of a patient who was allowed to get up for one hour on the second day of the puerperium (Fromme, *loc. cit.*). It has been maintained by some that early getting up, instead of predisposing to thrombosis and embolism, will actually tend to prevent these accidents, but Fromme's observation must be regarded as a serious blow to such an argument. Hinchey (*loc. cit.*) is of opinion that "inasmuch as no cases of death from hæmorrhage or embolism have occurred on account of early rising, and as there are even no good theoretical reasons for fearing such an accident, the subject may be dismissed until we have cause for alarm." The cause for alarm has been provided by Fromme's recorded case.



It may be found that a careful combination of systematic exercises in the horizontal posture during the early days of the puerperium, with rising not at the third, but about the seventh or eighth day, will give the best method of managing the puerperium; and Ballantyne has, during the autumn quarter of the present year (1909), used such a combination-treatment at the Edinburgh Royal Maternity Hospital in more than 100 cases.

**Pyelitis, Acute, in Infants.**—Acute pyelitis is not very rare in infants and young children. Its symptoms are misleading to those unacquainted with the disease. If undiagnosed it is an alarming illness, but it responds promptly to proper treatment. Little girls are much more often affected than boys, the reason being that the disease is due to an ascending infection with *b. coli*, to which the urinary tract in the female is obviously more liable than that of the male. The constitutional symptoms overshadow the local ones. There is sudden pyrexia, which persists until the pyelitis subsides. The temperature curve is remittent, and somewhat resembles that of typhoid. The children are much distressed, sometimes delirious, and sometimes show squinting. These head symptoms are apt to suggest the presence of a meningitis. Rigors are not uncommon; as they are very rare in infants except in this disease and malaria, their presence is highly suggestive. Dr. Thomson, to whom we owe the best treatment of pyelitis, says: "The four cases [of pyelitis] here referred to are the only instances in which I remember to have seen young children who had rigors; and I have not been able to find an account of any case in which this symptom occurred in a child under two years, who had not malaria, without there being pus in the urine." Local symptoms are so slight as readily to escape notice. There may be frequent and painful micturition, excoriation of the vulva, or fissure of the anus. Tenderness in the loin may be made out. The urine is always acid, generally extremely so, contains pus, and swarms with *b. coli*. The treatment is to render the urine neutral or alkaline by the administration of alkaline remedies as speedily as possible, and to keep it so until all the symptoms have disappeared (Thomson). Potassium citrate must be given in large doses (48 to 60 grs. or more in the twenty-four hours). Under this treatment the temperature speedily falls, and though the drug causes nausea and depression, it should be persevered with, because if it is prematurely discontinued, the temperature may rise again and the symptoms occur. Phosphate of soda may be given as a laxative if one is required.

REFERENCE.—THOMSON. *Scott. Med. and Surg. Journ.*, July 1902.

**Rectal Feeding.**—The influence of rectal alimentation on metabolism has been carefully investigated by Boyd and Robertson.

ABSORPTION OF NITROGEN.—Using white of egg, or white of egg and milk, they found that extremely little nitrogen was absorbed from nutrient enemata. The absorption, however, was as good when small quantities of proteid were given as with larger amounts—*e.g.*:—

Obs. VI. N of enema, 4.9; N absorbed, 2.22; Caloric value, 56.

Obs. I. N of enema, 11.43; N absorbed, 1.54; Caloric value, 39.

In Observation VI. the absorption of N was better than in any other case, though milk (which is generally regarded as being very poorly



assimilated by the bowel from enemata) was used. In all the cases observed by Boyd and Robertson the N-balance was negative.

ABSORPTION OF FAT.—There is a definite relation between the amount of fat given and the amount absorbed—*e.g.*:—

Obs. I. Fat of enema, 103·37 grm.; Fat absorbed, 45·85 grm.; Caloric value, 426.

Obs. VI. Fat of enema, 14·35 grm.; Fat absorbed, 3·47 grm.; Caloric value, 32.

The amount absorbed varied from 12 per cent. to 51 per cent. of that given. Fat absorption is an important factor in sparing nitrogen; emulsions of fat are very useful ingredients in enemata, and are much better absorbed than is generally supposed.

ABSORPTION OF SUGAR.—Pure dextrose was used. The amount of sugar lost by bacterial action is small, and the substance is well absorbed—*e.g.*:—

Obs. II. Dextrose in enema, 38 grm.; Dextrose absorbed, 38 grm.; Caloric value, 155.

Obs. V. Dextrose in enema, 88·14 grm.; Dextrose absorbed, 81·1 grm.; Caloric value, 332.

The proportion of sugar absorbed varied according to the different capacities in different individuals. Commercial dextrose may cause irritation of the bowel on account of impurities (*e.g.*  $\text{H}_2\text{SO}_4$ ), but pure dextrose is free from this drawback. Alimentary glycosuria is not produced by its use. Boyd found that in his cases the value of the food absorbed varied between 240 and 645 calories per diem, the average (389 calories) being only a quarter of the amount necessary, on the lowest computation, to maintain equilibrium. Even under very favourable circumstances rectal feeding is subnutrition of the most pronounced character. Given a patient in poor condition, it cannot be relied on to produce any material improvement—as, for example, in preparing patients suffering from pyloric or œsophageal obstruction for operation. The gain in weight which may, and often does, occur is due to absorption of water; the best results are got from enemata of sugar and fat; the absorption of proteid is so poor as to deprive this substance of any value. For practical purposes a good enema consists of:—Yolk of two eggs; 30 grm. pure dextrose; 0·5 grm. salt; pancreatised milk to 300 c.c. The approximate value of such an enema is 300 calories; given every 6 hours, the total represents 1200 calories, of which 500 might be absorbed under favourable circumstances. The method of administration is important. Nutrient enemata should never be given with a syringe, but should be slowly siphoned in with a small catheter and funnel. If the bowel is irritable, a small dose of morphia may be added. A daily cleansing saline injection is absolutely necessary. If an enema be given slowly, from 8 to 10 ozs. can be retained, and the patient absorbs sufficient water to quench thirst. Edsall arrives at very similar conclusions as to the limitations of rectal feeding. He suggests that in future better results may be looked for by work in the following directions:—Improvements in the emulsification of fat; the use of the ultimate digestion products of proteins—amino-acids, etc.; replacement of sugars by dextrans; the introduction of substances which tend to produce reverse peristalsis, and to pass through the ileo-cæcal valve into the small intestine.



In patients fed exclusively by the rectum *secondary parotitis* may occur. The side first affected is determined to a great extent by the position assumed by the patient, the gland which is most frequently in contact with the pillow being first attacked (Soltau Fenwick). An examination of the pus obtained from the abscess in the parotid, should suppuration occur, shows a variety of micro-organisms, the most constant of which—*s. pyogenes aureus* and *m. lanceolatus*—are also present in the thick secretions of the mouth. This secondary parotitis is most likely to occur when nothing at all, not even water, is allowed by the mouth, as in the treatment of hæmorrhage from a gastric ulcer. Oral starvation seems to be the principal factor in producing this parotitis. It depends on oral sepsis, with an ascending infection of Stenson's duct, the ascending infection being favoured by the lessened flow of saliva, and the difficulty in keeping the mouth sweet, when the functions of mastication and insalivation are in abeyance. Rolleston and Oliver state that it occurs ten and a half times more frequently in cases of gastric ulcer treated by absolute oral starvation than where water is allowed by the mouth. It is not prevented by antiseptic mouth-washes. Fenwick adopts the method of giving to the patients horse-radish, pellitory, or pieces of raw meat to chew, so as to promote a flow of saliva and prevent an ascending infection. A rubber teat is equally satisfactory. He states that where, as previously, a very large number of cases fed solely on large nutrient enemata developed secondary parotitis, he has not met with it once in his last 300 cases since adopting this simple device.

REFERENCES.—BOYD and ROBERTSON. *Scott. Med. and Surg. Journ.*, March 1906.—ROLLESTON and OLIVER. *Brit. Med. Journ.*, 29th May 1909; SOLTAU FENWICK. *Ibid.*—EDSALL. *Amer. Journ. Med. Sci.*, Nov. 1906.

**Reflexes.**—Since the great diagnostic importance of Babinski's sign (extensor plantar response) has been recognised several other reflexes connected with the foot have been described, but none of them is so generally useful as Babinski's. Oppenheim and White<sup>1</sup> have both pointed out that in many cases Babinski's sign may be elicited by stimulation of the skin of the middle of the leg, or the inside of the thigh, as well as by stroking the sole of the foot.

GORDON'S PARADOX FLEXOR REFLEX<sup>2</sup> is a reflex extension of the great toe produced by firm pressure on the relaxed muscles of the calf. The reflex does not occur in health; it has the same significance as an extensor plantar response—disease of the pyramidal tracts. To elicit the paradox flexor reflex the patient is seated with his feet on a low stool, the legs being flexed and slightly rotated outwards. The examiner stands on the outer side of the leg, and presses firmly over the middle and lower third of the calf muscles.

BECHTEREW'S DORSAL FOOT REFLEX.<sup>3</sup>—When the outer aspect of the dorsum of the foot in the region of the cuboid bone is tapped with a percussion hammer, a more or less distinct extension of the toes, from the second to the fifth, or of some of these, occurs. In many cases of organic nervous disease, accompanied by spastic paralysis of the legs, the extensor movement is replaced by flexion. The reflex is abolished in tabes, polyneuritis, and poliomyelitis. A flexor reflex is accompanied by positive Babinski, but positive Babinski is not always associated with Bechterew's flexor reflex. Osann, after a careful study of the reflex, concludes (1) that it is a direct muscular reflex,



depending on stimulation of the extensor brevis digitorum; (2) that its absence is not important; (3) that the flexor reflex is pathological, and occurs in spastic paralysis, often with Babinski's sign; (4) that although these two are often associated, they are not essentially related: the plantar reflex is purely cutaneous, and independent of muscular tone; Bechterew's reflex is purely muscular, and depends on the presence of tonus.

**ACHILLES TENDON REFLEX.**<sup>4</sup>—This is most easily tested by making the patient kneel on a padded stool or chair with the feet hanging over the edge, and tapping on the tendo Achilles with a stethoscope or percussion hammer. It is as constantly present in health as the knee-jerk, and its abolition has the same significance as loss of the knee-jerk. Out of 3290 patients, Congen found that it was diminished or absent only under pathological conditions.

**TOE-REFLEX (ROSSOLIMO).**<sup>5</sup>—This is a pathological reflex which, according to Rossolimo, is observed only in affections of the pyramidal tract. It is elicited by gently stroking the plantar surface of the great toe, whereupon, after a longer or shorter time, flexion or abduction of the toe occurs. The great toe, the other four toes, or all five, may show movements. It is said that the toe-reflex never occurs in neurosis, and that it may be present when Babinski's sign is absent.

**REFLEXES IN CHILDREN.**<sup>6</sup>—Engstler examined the plantar reflex in 1000 children. In newly-born children an extensor response is normal; from the sixth to the eighteenth month plantar and dorsal flexion are equally common; after the second year there is usually a flexor response. Anything which delays development—*e.g.* rickets—tends to hinder the transmutation of the one type of response into the other, but the flexor type may be found in children who have never walked. Practically, the examination of the plantar reflex is valueless below the third year.

The knee-jerk is constantly present from birth, and the Achilles jerk from the fifth or sixth month. The abdominal reflexes are absent in 80 per cent. of cases during the first month, in 65 per cent. during the second month, in 45 per cent. during the third month, and in 50 per cent. during the fourth month. The cremasteric reflex is constant after the eleventh month (Bychowski).

The lip-reflex of newly-born infants is referred to in connection with SPASMOPHILIA (*q.v.*). Moro has described another reflex in newly-born infants; it consists of a contraction of the orbicularis palpebrarum, which is brought about by tapping over the glabella or root of the nose. It is a protective reflex.

**REFLEXES IN INFECTIOUS DISEASES.**<sup>7</sup>—The abdominal reflex in typhoid fever is referred to under TYPHOID FEVER. This reflex is often abolished in cerebro-spinal fever. In pneumonia the knee jerk is often lost; its early disappearance (before the third day) is a sign of severe infection. Absence of the knee-jerk is of some use in diagnosing between lobar and broncho-pneumonia in children, for in the latter it is seldom abolished.

**KERNIG'S SIGN.**<sup>8</sup>—Normally, the extended leg can be flexed on the trunk almost to a right angle. In certain diseases, especially meningitis, when the thigh is flexed to a right angle with the trunk, the leg cannot be extended at the thigh; this is known as Kernig's sign. It is easily tested for with the patient lying on his back. The knee is raised until the thigh is vertical, and an attempt is made to raise the heel until the leg is horizontal. When the sign is well marked the hamstring muscles prevent the leg being extended beyond a right angle.



Kernig's sign is so constantly present in meningitis as to be of considerable value in diagnosis, but it is not pathognomonic. It also occurs in meningeal hæmorrhage, in some infectious diseases, especially typhoid, in uræmia, and occasionally in sciatica and lumbago. Kernig's sign is due to contraction of the hamstring muscles, and this in its turn has been ascribed to hypertonicity, either from increased pressure of the cerebro-spinal fluid, or irritation of the cord or nerve roots. Another explanation is that it is simply a reflex due to pain, its object being to prevent dragging on the roots of the sacral plexus. A different explanation is propounded by Moncano. According to him, flexion of the extended limb in the trunk involves rotation of the pelvis round a transverse axis; when the spine is rigid this cannot take place, hence complete flexion is impossible. Moncano believes that Kernig's sign is due to rigidity of the lumbar region of the spine, which is often met with in cerebro-spinal meningitis.

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**Rontgen Rays and Radium.**—1. RONTGEN RAYS. Many of the advances which have enlarged the sphere of usefulness of the X-rays in medicine and surgery—*e.g.*, the shortened exposure which is now required to obtain satisfactory skiagrams; the greater ease with which deeply seated strictures, such as the hip-joint or stones in the pelvis of the kidney, can be photographed; the more accurate localisation of foreign bodies in the eye and elsewhere—are due to improvements in technique and in the apparatus available. For information on these points a standard modern text-book, and the special journals on X-rays, must be referred to. Here only a general description of some of the advances will be given.

*Dangers of X-rays.*—The effect of the rays on normal skin is to produce (a) pigmentation, (b) erythema, and (c) blanching and loosening of the hairs. If exposures are continued an X-ray burn may occur. According to their severity, four degrees of burns are recognisable (Pusey and Caldwell). 1. Dry dermatitis without destruction accompanied by burning or tingling. It begins as a punctate redness round the follicles. If the process stops at this stage, there is some desquamation, and except for more or less residual pigmentation, recovery ensues. 2. Dermatitis with vesicles which rupture and leave a weeping surface. Healing is gradual. 3. Intense vesicular and bulbous dermatitis with superficial necrosis. The necrotic skin bleeds readily. Ulcers form, which heal slowly; recovery in from three or four weeks to as many months. The skin is left thin and softer than normal. 4. Intense congestion of the skin with necrosis of the skin and subcutaneous tissue. The sloughs separate very slowly, possibly requiring months to do so. Healing like an ordinary ulcer, except that the scar is more vascular.

Workers with X-rays who do not take precautions against unnecessary exposure are liable to develop a chronic dermatitis with atrophy



of the deeper layers of the skin. The backs of the hands are chiefly affected; the skin becomes thin and cracked, telangiectases develop, the nails become loose and brittle and the nail bed may suppurate. In not a few cases malignant disease has ultimately developed in such lesions.

The action of the X-rays on deeply-seated organs and tissues is referred to in connection with the treatment of LEUKÆMIA (*q.v.*). A further effect of exposure to the rays is sterility. Sexual power is unimpaired, but there is complete azoospermia. The changes in the testicle seem to require several months for their development, and the sterility which results is of considerable duration, or may perhaps be permanent.

The dangers of X-rays can be guarded against by avoiding unnecessary exposures, by the use of lead screens, and by a due regard to dosage. There is no specific treatment for the lesions; red light, blue light, high frequency currents, and, latterly, radium, have been tried. The earlier workers, ignorant of the potency of the radiations, have suffered, but with proper care these unfortunate results ought to become things of the past.

*Dosage of X-rays.*—Sequeira points out that after the application of the rays to an area of skin there is a latent period before reaction occurs. An evanescent erythema, probably due to actinic rays developed in the tube, appears a few hours after exposure. The true X-ray reaction follows this, in a week or more. Kienbock's classification of the degree of the reaction is useful:—

First degree: Latent period three weeks; no visible inflammation; temporary shedding of hair; diminution of lupus nodules.

Second degree: Latent period of two weeks: swelling and redness of the skin lasting one or two weeks; shedding of hair.

Third degree: Latency of ten days; redness, vesication, superficial erosion and exudation; the parts are restored to their natural condition in from three to four weeks.

Fourth degree: Latent period of a week or less; necrosis with ulceration, healing sometimes after six weeks or longer.

In all conditions except the first, there may be telangiectases in the scar. They are almost inevitable after an inflammation of the third degree. Such telangiectases may not appear for six to eighteen months after the exposure.

The output of X-rays from a tube can be estimated by Holzknecht's chromo-radiometer or Sabouraud's pastilles. In the former a capsule containing the reagent is placed near the part under treatment and as it changes colour under the influence of the rays it is compared with a graduated colour scale which reads from 3 to 24 "Holzknecht units." Sabouraud's pastilles are more generally used. They consist of little discs of barium platinocyanide in an emulsion of collodion and acetate of starch, and with them a standard tint is supplied. The pastille is placed midway between the anode and the skin. In treating ringworm the standard "B" tint cannot be exceeded without causing erythema. It is equal to 5 Holzknecht units.

*X-ray Therapeutics.*—Among the diseases in which the rays are most successfully employed are rodent ulcer, lupus, ringworm, mycosis fungoides, and other skin affections, in operable sarcoma, and leukæmia. Further information will be found under the various rubrics.

*X-ray Diagnosis.*—In addition to the diagnosis of diseases and injuries



of the bowels and diseases of the thorax, as described in the *Encyclopædia Medica* (Vol. XIII. p. 511), the position of the abdominal viscera can now be made out by the X-rays. As air-containing organs like the stomach and intestines cast no shadow, it is necessary to introduce into them some substance which will do so, and for this purpose bismuth carbonate or subnitrate is generally employed. In some cases a flexible tube filled with bismuth or mercury has been introduced—*e.g.* into the rectum or œsophagus—and information obtained from skiagrams taken with it *in situ*. Lilienthal, however, states that it is not possible to introduce a sound into the colon. Cannon adopted the bismuth method in his work on the movements of the stomach (see DIGESTION). For X-ray examination of the stomach Rieder's bismuth meal may be used. It consists of about half a pint of thick soup—potato purée—containing an ounce and a half of bismuth subnitrate. Instead of this a simple emulsion of bismuth in mucilage may be used. If the colon is to be examined the bismuth is given as a high enema—300 to 400 c.c. oil with 40 to 50 grms. of bismuth. Schule's radio-grams prove that in many cases the whole colon up to the ileo-cæcal valve can be demonstrated in this way.

It is obvious that this method of mapping out the internal organs may at times prove useful—*e.g.* in cases of dilatation of the stomach, enteroptosis, diverticulum of the œsophagus, etc. Hemmeter, of Baltimore, has suggested that it may be utilised in the diagnosis of gastric ulcer. Bismuth tends to adhere to the surface of ulcers after it has left the intact mucous membrane. Hemmeter gives to the patient a heaped teaspoonful of bismuth in a glass of water, and examines by the rays three or four hours later, by which time the bismuth will have left the stomach, except for such a part as clings to the surface of an ulcer and casts a circular shadow.

When large doses of subnitrate of bismuth are used as described above, it is advisable to wash out the stomach and remove as much of the bismuth as possible as soon as the desired end is attained. The reason for this is that from time to time cases of bismuth poisoning have been recorded, particularly in young infants. Apparently the nitric ion is responsible for the action; in the intestine it is converted into a nitrous ion, and leads to methæmoglobinaemia. Lewin has recently recounted a number of other untoward symptoms—gingivitis, albuminuria, etc., after the administration of these large doses of bismuth. He regards the other salts as just as toxic as the subnitrate, and advises that bismuth should be replaced in X-ray work by ferric oxide.

Voelker and Lichtenberg describe a method for skiagraphy of the kidneys based on the same principle. A ureteral catheter is passed up to the pelvis of the kidney, and a 5 per cent. collargol solution (which is impervious to the rays) is slowly introduced. The amount which can be injected without pain is from 5 to 40 c.c.

Tumours of the hypophysis in cases of acromegaly have been detected by means of skiagrams.

It has not yet been found possible to obtain skiagrams showing gall-stones.

*X-rays in Paediatrics.*—Rotch suggests that for many purposes a physiological and anatomical standard of development is superior to a mere age standard. As an index of development he proposes the development of the carpal bones and the lower epiphyses of the radius



and ulna as ascertained by X-rays. He believes that such an index would form a sounder basis for classification, as in connection with school work, athletics, child labour, etc.—than the age standard in use.

*Plastic Röntgengrams.*—So-called “plastic X-ray photographs,” in which the bones, instead of being mere shadow-pictures, show out their details in apparent relief, were exhibited for the first time by Alexander at the Medical Society of Buda-Pesth in 1906, and, as the method by which they were produced was kept secret for a time, a good deal of curiosity was excited and a number of papers on the subject appeared. The procedure, shortly, is this: The object to be photographed is exposed twice on the same plate, first with a hard, then with a soft tube. From the negative a positive is made, and the two are adjusted in contact and exact register. From the combined negative-positive a print or positive is then made. Plastic röntgengrams are certainly striking; whether they depict what actually exists, and how far they are merely results of a clever photographic dodge, is doubtful.

*Röntgen Kinematography.*—Having succeeded in getting skiagrams with exposures of  $\frac{1}{20}$ – $\frac{1}{10}$  sec., Geordel has devised an apparatus for obtaining serial views of the heart and stomach, which, when suitably projected, give a kinematographic representation of the movements of the organ.

*Orthodiagraph.*—The use of the orthodiagraph for the exact delineation of the boundaries of the heart is described on p. 210. The instrument has also been used to outline the stomach, etc.

2. RADIUM.—This remarkable substance was discovered by M. and Mme. Curie in 1898. The discovery was not made suddenly, but was led up to by researches extending back to the middle of the nineteenth century, when Geissler showed that an electric discharge through a vacuum tube caused the tube to glow. In 1879 Crookes discovered that the luminosity was produced at the negative end of the tube, and in 1895 Röntgen, finding that the rays from a Crookes's tube caused barium cyanide to fluoresce, was led to further experiments which culminated in the discovery of the Röntgen rays. J. J. Thomson proved that Crookes's cathodal rays consisted of a stream of negatively charged material particles, and that Röntgen's X-rays were a series of disconnected, non-periodic pulsations caused by the impact of the particles forming the cathodal rays against the glass of the tube. In 1896 Becquerel found that certain uranium compounds emitted a radiation akin to that of the Röntgen rays, but in very feeble amount. Following up this clue the Curies discovered that certain ores of uranium and thorium—the pitchblendes—were even more radio-active than the former element itself. After a laborious research, which involved separating pitchblende into its constituents and testing each separately, Mme. Curie showed that this radio-activity was due to two new elements—polonium, which about equals uranium, and radium, which in its pure state is about two million times as active.

Radium belongs to the group of alkaline metals; it is intermediate between barium and thorium, and has not been isolated in the pure state. It would probably behave like sodium and oxidise rapidly. The bromide and chloride of radium are the salts employed. These are extracted from pitchblende, and in the successive stages of this isolation Mme. Curie used an electroscope by which the ionisation of air by radio-active bodies can be detected. In this way she learned whether the radio-active substance she sought was in the precipitate or in the filtrate



after each step in the process. Pure radium chloride is a white crystalline salt with an atomic weight of 225. The amount present in different minerals bears a constant ratio (1:1,000,000) to their uranium content. A ton of Joachimsthal pitchblende yields about .17 gramme of radium.

Radium has the peculiarity of maintaining itself at a temperature of  $2^{\circ}$  to  $3^{\circ}$  Fahr. above the surrounding air—100 calories per gram per hour; it thus gives off enough heat every hour to melt its own weight of ice, and goes on doing this indefinitely without undergoing appreciable change. It also has the power of ionising gases; that is, it converts the air between the terminals of an electric current into a conductor—a property made use of in measuring radio-activity. Its third property is that of giving off an emanation, and emitting rays. The emanation is of the nature of a luminous gas which can be condensed by cold, and which imparts radio-activity to objects in its path. The radiations are divided into alpha, beta, and gamma rays. They all act on photographic plates, excite phosphorescence, and discharge electrified bodies. The  $\alpha$  rays consist of a stream of positively charged particles about twice the size of a hydrogen atom, projected at the rate of 20,000 miles a second. They have little penetrative power, being checked by a plate of aluminium .05 mm. thick, or a sheet of mica. They are slightly deflected in a magnetic field. The  $\beta$  rays are also material; they are only  $\frac{1}{1000}$  of the size of the  $\alpha$  particles, are negatively charged with electricity, and travel at the rate of 1,000,000 miles a second. Their penetration is a hundred times as great as that of the  $\alpha$  rays; they will pass through 5 mm. of aluminium, or 1 cm. of lead. They are readily deflected in the magnetic field. The gamma rays are not material; they carry no electric charge, and are consequently not deflected in a magnetic field. Their velocity is enormous, being about that of light, and their penetrating power is very great—10,000 times that of the  $\alpha$  rays. They pass through 50 cm. of aluminium, or one inch of steel. Rutherford and Soddy have shown that the  $\alpha$  rays are, if not identical with helium, at least very closely related to that element. Their equivalent rays in the Crookes's tube are the "di-cathode rays," *i.e.* the streams of light which pass back when holes are made in the cathode. The  $\beta$ -rays are identical with the cathodal rays of a Crookes's tube, and the  $\gamma$  rays nearly resemble the X-rays produced by a high vacuum tube. Thus the processes taking place in a particle of radium are very complicated. "In a compound of radium there occurs a rapid expulsion of  $\alpha$  and  $\beta$  particles, accompanied by the generation of the  $\gamma$  rays [for  $\gamma$  rays are dependent on  $\beta$  rays, just as the X-rays depend on the cathodal rays], a rapid emission of heat, the continuous formation of an emanation or gas, and the formation of an active deposit which gives rise to 'excited' activity" (Rutherford). The most feasible explanation of these phenomena is afforded by the "disintegration theory" of Rutherford and Soddy. "It is supposed that the atoms of the radio-active substances are unstable, and that a certain fixed proportion of them become unstable every second, and break up with explosive violence, accompanied in general by the expulsion of an  $\alpha$  or  $\beta$  particle, or both together. The residue of the atom, in consequence of the loss of an  $\alpha$  particle, is lighter than before, and becomes the atom of a new substance, quite distinct in chemical and physical properties from its parent."

The emanation is, as Rutherford says, the concentrated essence of the



radio-activity of radium; and is about 100,000 times as radio-active as radium. In a dry atmosphere radium emits very little emanation; the emanation is stored up in the mass of the radium bromide or chloride, but is released by heat or solution. It behaves like a heavy gas, but is not permanent, and undergoes disintegration with the further expulsion of  $\alpha$  particles and their deposit on surrounding bodies. Its transformation is accompanied by an enormous evolution of heat; 1 c.c. would probably at once melt down a glass tube containing it. Radium which has been freed from emanation and the active deposit by heat or solution, suffers great diminution in its activity and emits only  $\alpha$  rays. It recovers, however, as more emanation is produced and stored up in its mass. As has been said, bodies which come in contact with the emanation become temporarily radio-active.

*Medical Uses of Radium.*—On the whole, the medical uses of radium are not very dissimilar to those of the X-rays. As radium is usually applied in a capsule protected by a mica shield, it seems impossible that the  $\alpha$  rays have anything to do with its action. M'Intyre, writing in 1903, expresses the opinion that its great activity was due to the  $\beta$  rays, seeing that the  $\gamma$  rays were present in such small amount as compared with the X-rays given off by a Crookes's tube. In a recent address Treves alludes to the necessity of further experiments with the view of ascertaining which radiations ought to be employed in different conditions, and quotes the favourable results obtained by Dominici using long exposures to the ultra-gamma rays. The different rays can, of course be cut off by suitable thickness, of screen.

Radium can, of course, be used to take skiagrams, but its cost, and the small quantities in which it is procurable, militate against this use of it.

*Physiological Effects.*—Exposure to radium causes dermatitis, which may go on to intractable ulceration. A latent period of 8 to 10 days elapses before these effects are produced. Application of radium of 1,000,000 strength for 3 hours will cause dermatitis; for 10 hours, ulceration. When radium is brought near the closed eye, and even, in some cases, near a blind eye, a sensation of light is produced; this is due to fluorescence of the ocular media. Radium is inimical to animal life. The introduction of a tube containing 1 mg. of radium bromide under the skin of a mouse causes convulsions, paralysis, and death. After prolonged exposure the growth of tadpoles is checked, seeds fail to germinate, and other larval forms of life lose their power of development. The radiations are said to inhibit the growth of some bacteria, and to kill others. Their bactericidal power, however, is feeble: three days' exposure to 25 mg. radium is required to destroy the germs of anthrax, cholera, and typhoid. Attempts to sterilise milk in this way have failed. It should be noted that the action is greatest in young forms—a fact which may be related to the rather selective effect of the rays on cancer cells. Thies found that the rays affect all animal tissues, the adenoid tissues and skin being most susceptible. The epidermis dies, or, under certain circumstances, undergoes proliferation and produces a species of neoplasm. The arteries contract; striped muscle undergoes colloid degeneration; elastic fibres are most resistant. Heinecke, to whose work so much of our knowledge of the tissue changes caused by the X-rays is due, states that the effects of radium are identical; the action on hair, skin, and testicles is the same in both cases.



*Therapeutic Uses.*—Treves speaks of the following conditions as curable by radium:—1. Angiomata, including “port wine” stains, nævus, pigmented moles, hairy moles, and fibrous angiomata. 2. Skin affections, including chronic eczema with itching, keloid following operations, and acne keloid. 3. Rodent ulcers, even when they are of old standing, adherent to bone, and have resisted treatment by Finsen light, X-rays, and cataphoresis. 4. Epithelioma of the tongue and lip and adjacent parts. In one case of epithelioma cured by radium the face was perfectly sound at the end of two years. Butcher states that small tumours wilt and wither away after a few exposures. There is first spasm of the vessels, congestion, cutaneous reaction, and then pigmentation. Good results have been reported in lupus vulgaris, particularly lupus of the mouth (Walker), lupus erythematosus, scleroma of the nose and larynx, melanoma (Lassar), tics, neuralgia, optic atrophy, tuberculous ulcer of the tongue, cancer of the œsophagus, trachoma (Dinger).

Dr. Louis Wickham, in an address to the Dermatological section of the Royal Academy of Medicine, stated that naked radium gives off 90 per cent. of  $\alpha$ , 9 per cent. of  $\beta$ , and 1 per cent. of  $\gamma$  rays; whereas when fixed in the apparatus used for therapeutic purposes in the Paris Institute, the ratios are altered to 1 per cent.  $\alpha$ , 90 per cent.  $\beta$ , and 9 per cent.  $\gamma$ . The  $\beta$  rays are divided into soft, with little penetrative power, middle, and hard, with a penetrative power approaching that of the  $\gamma$  rays. A lead screen filters off all the  $\alpha$  and most of the  $\beta$  rays, leaving only 10 per cent. of hard  $\beta$  and 90 per cent. of  $\gamma$  rays. The soft  $\alpha$  and  $\beta$  rays are those which injure the skin; for the hard lead-penetrating  $\beta$  and  $\gamma$  rays an elective power over cancerous tissues is claimed. This specific action has been demonstrated towards eczema, angioma, keloid, and cancer.

Wickham summarises the advantages of radium under the following heads, with the reservation that they are not of universal application:—1. The treatment can be applied without inconvenience to the patient in his daily work. 2. The interposition of the lead screens renders the action of the rays on tumours slow and on healthy tissues harmless. 3. “Crossfire” application (*i.e.* the attack on the tumour from different sides, as, for example, in epithelioma of the lip) compensates for the great diminution in radiations caused by lead filtration. 4. The radiations exert their special action at a depth. 5. In cancer of the breast radium can—(*a*) cause retrogression to such an extent as to give the appearance of a cure; (*b*) transform an inoperable into an operable cancer; (*c*) act on recurrences following operation; (*d*) act on cancerous glands if not too extensively involved; (*e*) prolong life in incurable cases by relief of pain, hæmorrhage, and discharge; (*f*) act as a prophylactic against recurrence after surgical intervention.

*Method of Application.*—An active preparation must be used—at least 10 mg. of pure radium bromide of 1,000,000 strength. The average sitting is from 20 to 45 minutes, but some authorities advise much shorter sittings—1 to 4 minutes. Radium may be enclosed in a glass or aluminium capsule, or a lead capsule with a mica or aluminium window. Treves recommends the form of apparatus used at the Radium Institute in Paris—plates coated with radium so as to utilise as large a surface as possible. The exposure is about an hour, or, if screened so as to cut off all but the ultra-gamma rays, several hours at a time. Exposure may be made daily, then weekly.



Treves also quotes a statement that a solution of the radium emanation injected into a mouse infected with mouse cancer cured the cancer. The idea of utilising the emanation has been adopted by exposing saline solution to radium and using the radio-active solution for douches, etc. The waters of many mineral wells—*e.g.* Bath—are radio-active; possibly some part of their action is due to this. Of a number of radio-active bodies, the only ones which require mention are thorium and uranium. The latter has been employed as a plaster in skin disease (Walker). Thorium, which is the principal ingredient in incandescent gas mantles, was suggested by Soddy as worthy of trial in phthisis, and he described a method of producing it in a form suitable for inhalation. Thorium has been employed as an ointment in malignant and other ulcers.

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**Schools and School Children, Medical Examination of.**

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1. INTRODUCTORY.—Medical inspection of school children is not a new proposal; it has been practised for many years in the great public schools of England, in a large number of private schools, in all the industrial and reformatory schools, and in the Poor Law schools. In all these institutions, however, the intention of medical inspection has been to see that the health of the pupils is maintained. This involves treatment as well as inspection. Neither treatment nor inspection has hitherto had any special relation to the school child as such; the purpose of it has rather been to satisfy parents and public bodies that the children are medically protected. Recently, the movement for medical inspection of school children has taken a wider sweep. In Britain, the immediate cause of this greater movement was the South African War. For years it had been found that too large a proportion or recruits had to be rejected for ailments of many kinds; the necessity



for increased superintendence of physical growth became manifest, and the Royal Commission on Physical Training (Scotland) was appointed in 1903. The evidence laid before this Commission made it clear that many of the defects found at the recruiting stations had their origin in early life; that physical training in schools could not be efficiently developed except under medical supervision; that, even for the purposes of general education, medical inspection of the school children was called for. The Commission, having very few scientific facts to guide them, ordered an examination of twelve hundred representative Scottish school children. The facts emerging in this investigation, limited though it was, were more than sufficient to justify the Commission in recommending medical inspection. The Commission's Report made a strong impression everywhere. In the following year, 1904, there was appointed an Inter-departmental Committee on Physical Deterioration. This Committee followed the lead of the Scotch Commission, but widened the scope of the inquiry. In their report they recommended medical inspection of school children as one among some fifty suggestions for the prevention of physical deterioration. Meanwhile, facts were accumulated from Glasgow, Dundee, and some other centres. It is estimated that over ten thousand children from Scottish schools have been carefully examined.

In many towns of England, Medical Officers, under the powers of the Education Act, 1902, were appointed to examine the school children. A second Inter-departmental Committee prepared an elaborate report on the extent to which school authorities had exercised their powers under the Act. It was found that a large number of authorities had appointed Medical Officers of Health and other medical men to superintend the health of the schools, and, in certain cases, to make detailed examination of the children. In London, many years ago, while as yet education was under the direction of the London School Board, a Medical Officer of Schools had been appointed. When the Board was superseded by the London County Council, the Medical Officer (Education) was transferred, and remains as a leading officer of the County Council. He has a large staff of male and female medical assistants, some giving their whole time, others part of their time, to the work. There is also a staff of special nurses and visitors. In Bradford, for many years, medical inspection of schools had attained to a high level of elaboration. Both in Bradford and in London, Dr. James Kerr was a pioneer. His London reports are always rich in new materials for the study of School Hygiene. Further details of the position of medical inspection in England before 1907 may be obtained from the Report by the Inter-departmental Committee on Medical Inspection, etc.

In 1907, the Education (Administrative Provisions) Act was passed. By section 13 of that Act the Local Educational Authorities received the following powers:—(a) "Power to provide (for children attending Public Elementary Schools) vacation schools, vacation classes, play centres, etc.; (b) the duty to provide for the medical inspection of children immediately before, or at the time of, or as soon as possible after, their admission to a Public Elementary School, and on such other occasions as the Board of Education direct; and the power to make such arrangements as may be sanctioned by the Board of Education for attending to the health and physical condition of the children educated in Public Elementary Schools: provided, that in any exercise



of powers under this section, the Local Educational Authorities may encourage or assist the establishing or continuance of voluntary agencies, and associate with itself representatives of voluntary associations for the purpose." This section came into operation on the 1st day of January 1908. Meanwhile, the English Board of Education had already constituted a new Medical Department. Dr. George Newman was appointed Medical Officer to the Board, with a staff of assistants. On the 22nd of November 1907 the Board issued an elaborate "Memorandum on Medical Inspection of Children in Public Elementary Schools, under section 13 of the Education Administrative Act of 1907" (Circular 576). This memorandum, which extends to twelve pages, is an admirable discussion of the general problem as it affects England. It shows the relation of the school to the home; the necessity for maintaining this relationship; the importance of the many public health problems issuing from the schools; the need for co-operation between teachers and doctors; the organisation of inspection; the character and degree of medical inspection, and a large number of other details. The general scheme thus outlined was, later, made more definite by the issue of a schedule, which, on the whole, fulfils the original promise of the Circular, but does not give the expected prominence to the investigation of the home conditions. The Circular had been discussed by the British Medical Association, whose Committee also produced an elaborate schedule. The medical profession, in every branch, both general and special, has taken up the movement warmly, and already (1908) the organisation of it has proceeded with lightning-like rapidity. (For schedule, see below.)

In Scotland, the statutory organisation of the movement has proceeded less rapidly, but meanwhile much actual work has been done. The School Board of Edinburgh has appointed a whole-time Medical Officer of Schools (see regulations below). The Burgh of Kirkcaldy, in concert with the School Board, has made the Medical Officer of Health also Medical Inspector of Schools. The School Board of Govan have appointed ten private practitioners as part-time Medical Officers of Schools. The Medical Officer of the Dunfermline Carnegie Trust also acts as Medical Inspector of School Children, and has already issued two annual reports. The School Boards of Inverness and of one or two other localities have appointed Medical Officers. In the counties, the County Medical Officers of Health have, within the last two or three years, given special attention to the medical and sanitary supervision of schools, and several of them have issued elaborate statements in their annual reports.

The School Board of Glasgow, in 1906, issued a report of the examination of the eyes of fifty thousand school children, and in 1907 the Scotch Education Department tabulated the results of the examination of the heights, weights, and housing of seventy-two thousand Glasgow school children (see below). Meanwhile, at the Training Centres for teachers—Edinburgh, Glasgow, Dundee (St. Andrews), and Aberdeen—Medical Lecturers have been appointed by the Provisional Committees to give to the "students in training" instruction in School and Personal Hygiene, with special reference to the ultimate establishing of a complete system of medical inspection. The Training Centres are now, with the exception of the Episcopal Training College, Edinburgh, and the Roman Catholic Training College, Glasgow, under the sole management of the Provincial Committees, and the four Medical Lecturers



devote their whole time to the work, receiving such medical and lay assistance as may be rendered necessary by the large classes. The two Denominational Colleges have also Lecturers, but they give only part of their time to the work. In all, there are some nine medical men or women devoting, with two exceptions, practically their whole time to the work of teaching Personal and School Hygiene. When, therefore, medical inspection comes to be organised in Scotland, the younger generation of teachers will be fully prepared for it. Further, in the end of 1907, the Scotch Education Department issued directions for the Cleansing and Disinfecting of Schools. Under the conjoint authority of the Scotch Education Department and the Local Government Board for Scotland, these directions have been circulated among all the School Boards and Public Health Local Authorities and Officials of Scotland. By these various methods the way has been prepared for the medical inspection of school children in Scotland. In the Bill now (1908) before Parliament a clause has been inserted to do for Scotland what the Act of 1907 did for England, namely, to establish a full system of Medical Examination and Supervision of School Children.

So far Great Britain. But in Germany, Switzerland, France, Austria, America, Japan, and some other countries, medical inspection has been established for several years. For example, in Wiesbaden the school children have been medically inspected on admission and periodically thereafter since the year 1898. In Nuremberg, a similar system has been in force for about the same period. In Berlin, Charlottenburg, Vienna, and many other towns the same is true. In a considerable number of towns, in Germany and elsewhere, elaborate investigations have been made into the eyes of school children. In fact, it may now be said that medical inspection is practically established, in greater or less degree, in all civilised countries.

Medical inspection and the reports following upon it formed a leading part of the First International Congress on School Hygiene, which was held in Nuremberg from the 4th to the 9th of April 1904. At that Congress there were some fifteen hundred delegates of all nations. The report of the Congress forms four volumes of over five hundred pages each. These volumes are repertories of facts and investigations into the whole hygiene of school life.

The Second International Congress was held in London in August 1907. Medical Inspection of School Children was specially discussed, and no doubt this discussion had much to do in determining the lines of the Circular issued later by the Board of Education. As at Nuremberg, so at London, great masses of material bearing on medical inspection were produced, and will be made available in the report of the Congress. The third Congress meets in Paris in 1910.

These facts show that the medical inspection of school children is no isolated phenomenon. It is part of a world movement towards personal hygiene. Hitherto, the energies of the Public Health movement have been mainly exercised in securing a good environment. The new public health departure of the twentieth century is the effort to increase the capacity and fitness of the organism. The fundamental proposition of this movement is that the early nurture of the child is a primary factor in the development of the adult. Incidentally, the school child is selected for detailed examination because the schools are public institutions, great masses of children are easily found there, and it is on every hand recognised that education, either physical or mental, cannot pro-



duce effective results where the children suffer from disease or physical defects. Hitherto it has been assumed that the children are normal; this assumption has been displaced by masses of facts to the contrary. And, practically within three years, the public mind of Great Britain has been won over to the view that medical inspection of school children at the public cost is a necessity of our present social condition.

2. THE SCOPE AND NATURE OF MEDICAL INSPECTION.—The work that falls to a medical inspector of schools will best be understood from a concrete case. The following is a summary of the duties required of school doctors in the town of Wiesbaden.

The school doctor exercises a general supervision over the pupils, the schoolrooms, sanitary appliances, bathing installations, and all other conditions affecting the health of the children. He must make a systematic examination of all pupils on admission, recording the results in a schedule. He must mark off those that require special medical supervision during their school course, all those to be exempted from gymnastics or any special class, all those that are not equal to the full course of instruction, all those requiring special positions on account of defective eyesight or defective hearing. The schedule containing these details accompanies the child all through his school course; it is handed from teacher to teacher as the child passes from class to class, and if the child is transferred to another school, he takes the schedule among his papers. The doctor, under the heading "General Constitution," must state for each child whether the constitution is good, medium, or bad. The term "good" is to be used only where the health is perfect, and "bad" only in pronounced cases of illness or chronic ailments. The pupils are weighed and measured by the teachers, and the results are also recorded on the schedule every half-year. The height is taken to the half centimetre and the weight to the quarter of a kilogram. The chest measurement is made by the doctor, but only in children suspected of lung diseases.

Every fortnight, and oftener if there is infectious disease, the school doctor visits the school. Usually a room is placed at his disposal in the school. He consults with the head master; he visits the class where any case has been set aside for his inspection; he spends part of the time observing the conditions of the class; he examines systematically any cases brought before him, and he records his observations and instructions. Each class must, if possible, be visited twice during the half-year. This examination of the class is very brief. Usually the teachers prepare a list of the cases. The doctor, at those visits, makes a rapid inspection of the ventilation, the heating, the deportment of the children, etc. The particular class teacher must be present at the medical examination. Medical treatment of the children is no part of the school doctor's duties. Children requiring treatment are, through the head master, recommended to the family physician or to the Poor Law doctor or any available dispensary or clinic. With the older children, such recommendations are given by word of mouth, but in many cases a written recommendation is sent to the parent. Where no result follows the verbal recommendation, a special report form is filled up. But this is done only where the illnesses are serious. The headmaster is responsible for sending this report to the parent.

Where no other sufficient medical certificate is forthcoming, the school doctor must, at the instance of the headmaster, visit the homes in order to ascertain whether absence from school is justified.



Twice a year—once in summer and once in winter—the school doctor must examine the school premises and installations. His observations must be recorded in a register kept for the purpose. If any defects found are not remedied, he reports the matter to the School Hygiene Committee. In special cases, he may give notice to the school inspector and to the Medical Officer of Health of the district. In winter, the school doctor gives to the teacher short expositions on the most important questions of school hygiene.

Each year he prepares a report to the educational authority (the municipality). This report includes (1) a tabular numerical statement of the results of the admission examinations; (2) the number of medical visits to the classes; (3) the number and kind of the more important cases of illness discovered at those visits; (4) any special medical instructions, such as the remitting of instruction, gymnastics, etc.; (5) the number of written reports sent to the parents; the number of school children remaining under medical control; a summary of the instructions given on the hygiene of the school.

3. PRACTICE OF MEDICAL INSPECTION.—The extent of the examination to be undertaken at school depends on the purpose of medical inspection. This purpose is to prevent unfit children from entering on a course of instruction; to eliminate from the school such unfit children as are found there; to discover all such defects as interfere with the education of the child; to indicate what measures must be taken to have all defects remedied or ameliorated. Incidentally, the examination may serve strictly scientific ends; but the primary end is not scientific statistics, but the practice of education. Accordingly, the devising of a practical schedule becomes a matter of serious consequence. The schedule should include only what is practicable within school conditions and necessary for the full education of the child. In the schedule devised by Professor Matthew Hay for the Physical Training Commission (Scotland) there were included a large number of items that had only a scientific interest. In the schedule devised by the present writer for routine medical inspection all the main clinical items of Professor Hay's schedule were retained; some hygienic items were added, but the items of merely scientific interest were dropped. (See *The Medical Inspection of School Children*, Appendix.)

It is not advisable to overload this article with a variety of schedules; but the relation of the home to the school is of such primary importance that I transcribe the first section of the schedule that seems to me best.

#### I. ADDRESS, OCCUPATION OF PARENTS, ETC.

Session began.....  
 Date of Medical Inspection,.....  
 Name of pupil,.....  
 Date of birth,.....day,.....month,.....year.  
 Place of birth,.....  
 Age — years and months,.....  
 Residence or address,.....  
 Number of rooms in house,.....  
 Number of family and lodgers in house,.....  
 Father's occupation,.....  
 Mother's occupation (if any),.....  
 Does pupil work before school hours?.....  
 Does pupil work after school hours?.....  
 If so, at what occupation?.....



All these items have a direct bearing on the capacity of the child for school work. Now that feeding of children has become a possible duty of the school authority, the above items are all the more important.

In other respects practically all the same items, with detailed directions, have been included in the schedule issued by the English Board of Education. The home conditions may be recorded under "General Observations," etc. This schedule is of such importance, both historically and practically, that we reprint it here. It has been issued in a card form, with a full circular of directions.

*Circular to Local Education Authorities.*

*Schedule of Medical Inspection.*

Circular 582.

BOARD OF EDUCATION,  
WHITEHALL, LONDON, S.W.,  
23rd January 1908.

#### EDUCATION (ADMINISTRATIVE PROVISIONS) ACT, 1907, SECTION 13.

1. The accompanying Schedule has been drawn up in response to requests which the Board of Education have received for further and more definite guidance as regards the details of the work of medical inspection than was given in the Memorandum (Circular 576) which was issued by the Board on 22nd November 1907. The Board have, indeed, been pressed by many Local Education Authorities to issue a complete set of Forms for use in carrying out the work directly or incidentally involved in the performance of these new duties. Any Forms which experience of the working of the Act may show to be necessary or desirable will be issued in due course, but for the present the Board think it expedient to leave considerable latitude, subject to the considerations hereinafter set out, in regard to the particular Forms or Schedules to be used in different cases or circumstances.

2. The chief difficulties to be considered are administrative rather than educational or scientific. There is comparatively little dispute as to the end in view, or as to the means which, from the technical standpoint of medical science and practice, should be adopted for its complete attainment.

But the existing resources of Local Education Authorities are (for practical purposes, at all events) not unlimited, the feelings and prejudices of parents have to be considered, and a new element has to be introduced into school life and organisation with the least possible disturbance and inconvenience. Moreover, in this case two departments of local public administration are brought for the first time into organic connection—those of public health and of public education.

3. The Board are fully aware of these difficulties, and in preparing their Memorandum and Regulations it was necessary for them to consider what system would best reconcile the theoretical and practical considerations, and overcome the divergence between the ultimate end and the end immediately attainable, or between the methods which are scientifically desirable and those which can be applied in existing circumstances at the initiation of the work under the Act.

4. In the accompanying Schedule the Board indicate the particulars, attention to which they regard as constituting the *minimum* of efficient



medical inspection, and they consider that at least these particulars should be included in any other Schedule which the Local Education Authority may authorise for use in their Schools. It deliberately excludes many points of anthropometric or statistical interest which are worthy of attention, and which it is hoped may receive attention in suitable districts. Nor does it profess to lay down the lines of a clinical study or of a scientifically complete medical examination. It is intended to indicate the methods which, in the Board's opinion, should be followed and the particulars which should be attended to for the purpose of determining the fitness of the individual child for school life, to guide the Authority in adapting education to the peculiarities or abnormalities of the child, and to prepare the way for measures for the amelioration of defects in the child or its environment.

A more elaborate and complete form could readily be devised, but the Board's knowledge of the circumstances in which the work is to be done leads them to believe that greater elaboration would in the majority of cases defeat its own end.

5. If this Schedule is properly used, few cases of serious physical weakness or defect will escape detection. Where the ordinary inspection shows the need of further and more searching medical examination a supplementary blank form should be used in which particular defects or diseases should be fully recorded. It may facilitate inspection if the Schedule is printed on cards<sup>1</sup> (8 ins. by 5 ins. or 10 ins. by 6 ins.). The notes are included in the attached form for the convenience of the School Medical Officer, and should not be reprinted on the cards. Of course it is not necessary that negative findings on all the points mentioned in the notes should be recorded.

It will be noticed that a space is reserved in the Schedule for "General Observations"; this may conveniently be used to record a general summary of the condition of the child, and any information which may be available as to the home environment, or other conditions affecting its health.

It is considered that the inspection of each child should not occupy on the average more than a few minutes, and that the child need only, as a rule, have its clothes loosened or be partially undressed. Time may be saved in the actual inspection by the Medical Officer if the entries in some of the spaces are filled in by the school authorities before his visit. The four columns in the Schedule are designed for the four inspections required during school life.

With regard to items 17 to 24 of the Schedule, while it is necessary that all indications of diseased or unsound conditions should be thoroughly investigated, needless medical examination of healthy children should, for obvious reasons, be avoided.

6. Where children are found to belong to that class of "defectives" for whose education special provision is or ought to be made under the Statutes relating to such children, such cases should be made the subject of a special report to the Local Education Authority.

7. *All entries of the results of inspection in each individual case must be regarded as confidential.*

<sup>1</sup> Specimen cards are enclosed, but cards will not be supplied with the copies of this Circular which are placed on sale.



## SCHEDULE OF MEDICAL INSPECTION.

(Accompanying Circular 582.)

## NOTES FOR INSPECTING OFFICER.

Reference  
Number  
of Note.

1. Date of birth to be stated exactly, day of month and year.
2. "Other illnesses" should include any other serious disorder which must be taken into account as affecting, directly or indirectly, the health of the child in after-life, *e.g.* rheumatism, tuberculosis, congenital syphilis, smallpox, enteric fever, meningitis, fits, mumps, etc. The effects of these, if still traceable, should be recorded.
3. State of any cases of, or death from, phthisis, etc., in family.
4. Note backwardness.
5. Age to be stated in years and months, thus  $5\frac{4}{12}$ .
6. Insufficiency, need of repair, and uncleanness should be recorded (good, average, bad).
7. Without boots, standing erect with feet together, and the weight thrown on heels and not on toes or outside of feet.
8. Without boots, otherwise ordinary indoor clothes.  
Height and weight may be recorded in English measures if preferred. In annual report, however, the final averages should be recorded in both English and metric measures.
9. General nutrition as distinct from muscular development or physique as such. State whether good, normal, below normal, or bad. Under-nourishment is the point to determine. Appearance of skin and hair, expression and redness or pallor of mucous membrane are among the indications.
10. Cleanliness may be stated generally as clean, somewhat dirty, dirty. It must be judged for head and body separately. The skin of the body should be examined for cleanliness, vermin, etc.; and the hair for scurf, nits, vermin, or sores. At the same time ringworm and other skin diseases should be looked for.
11. General condition and cleanliness of temporary and permanent teeth, and amount of decay. Exceptional features, such as Hutchinsonian teeth, should be noted. Oral sepsis.
12. The presence or absence of obstruction in the naso-pharynx is the chief point to note. Observation should include mouth-breathing; inflammation, enlargement, or suppuration of tonsils; probable or obvious presence of adenoids, polypi; specific or other nasal discharge, catarrh, malformation (palate), etc.
13. Including blepharitis, conjunctivitis, diseases of cornea and lens, muscular defects (squints, nystagmus, twitchings), etc.
14. To be tested by Snellen's Test Types at 20 feet distance (= 6 metres). Result to be recorded in the usual way, *e.g.* normal  $V.=\frac{6}{6}$ . Examination of each eye (R. and L.) should, as a rule, be undertaken separately. If the V. be worse than  $\frac{6}{9}$ , or if there be signs of eye strain or headache, fuller



Reference  
Number  
of Note.

- examination should be made subsequently. *Omit vision test of children under six years of age.*
15. Including suppuration, obstruction, etc.
16. If hearing be abnormal or such as interferes with class work, subsequent examination of each ear should be undertaken separately. *Apply tests only in general way in case of children under six years of age.*
17. Including defects of articulation, lisping, stammering, etc.
18. Including attention, response, signs of overstrain, etc.  
The general intelligence may be recorded under the following heads:—(a) Bright, fair, dull, backward; (b) mentally defective; (c) imbecile. *Omit testing mental capacity of children under six years of age.*
19. Under the following headings should be inserted particulars of diseased conditions actually present or signs of incipient disease. The extent of this part of the inspection will largely depend upon the findings under previous headings.
20. Include heart sounds, position of apex beat, anæmia, etc., in the case of anything abnormal or requiring modification of school conditions or exercises.
21. Including physical and clinical signs and symptoms.
22. Including chorea, epilepsy, paralysis and nervous strains and disorders.
23. Glandular, osseous, pulmonary, or other forms.
24. State particular form, especially in younger children.
25. Including defects and deformities of head, trunk, limbs. Spinal curvature, bone disease, deformed chest, shortened limbs, etc.
26. Including any present infectious, parasitical or contagious disease, or any sequelæ existing. At each inspection the occurrence of any such diseases since last inspection should be noted.
27. Any weakness, defect or disease not included above (*e.g.* ruptures) specially unfitting child for ordinary school life or physical drill, or requiring either exemption from special branches of instruction, or particular supervision.

*Schedule of Medical Inspection.*

I.—Name\_\_\_\_\_ Date of Birth <sup>1</sup>\_\_\_\_\_  
Address\_\_\_\_\_ School\_\_\_\_\_

II.—Personal History :

(a) Previous Illnesses of Child (before admission).

Measles.	Whooping-Cough.	Chicken-pox.	Scarlet Fever.	Diphtheria.	Other Illnesses. <sup>2</sup>
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(b) Family Medical History (if exceptional).<sup>3</sup>







that the developments will be great is beyond doubt. A new type of "clinical medicine" has thus arisen on the borderland between gross disease and perfect health. This new specialism is determined by the needs of educational practice, which can no longer proceed on the assumption that every child is normal and every mind equally fitted for instruction. But the need of thus at once adapting education to the child and the child to education elevates on to a higher plane all the minor ailments and defects. The result will be an enormous expansion of the preventive functions of the medical profession. No doubt, also, the question of hospital and private treatment will receive an immense impetus. Already one result of medical inspection in London, as in other parts of England, has been to stimulate the discussion of how to discover diseases and how to arrange for their treatment. The same problem has already emerged in Scotland. It may be expected that, as time advances, the treatment both of minor and major ailments will steadily increase and the functions of the medical profession will grow in importance.

#### EDINBURGH SCHOOL BOARD.

##### *Regulations for the Medical Officer of Schools.*

1. He shall advise the Board as to new sites, plans of new Schools, and also, when required, as to School apparatus; he shall exercise a general supervision over the ventilation, heating, lighting, and cleanliness of the Schools; he shall periodically inspect all school lavatories and other sanitary installations, and he shall report immediately to the Headmaster, and, if necessary, to the Superintendent of Works, any insanitary conditions discovered.

2. On receiving intimation of an outbreak of infectious disease among the pupils attending any School, he shall at once inquire into the outbreak; he shall take such action as may be immediately necessary; and he shall, as soon as practicable, report the result of this inquiry to the Board, and to the Medical Officer of Health for the city, and shall co-operate with him in any measures he may propose for the prevention of infection.

3. He shall advise the Board as to the necessity for periodic disinfection and cleansing of the Schools, with a view to the prevention of disease.

4. He shall make such examination as the Board may require as to the medical and physical condition of children selected for Special Schools or Classes, and shall grant any necessary certificates.

5. He shall medically superintend all Special Schools and Classes; he shall keep the Board informed of the mental and physical progress of the children, and he shall indicate any measures that may be advisable for the preservation or promotion of their health.

6. On receiving intimation from the Chief Attendance Officer that a child is absent from School on account of alleged illness, he shall, where a medical certificate is not produced, inquire into the case and report to the Board.

7. He shall advise the Board as to the children remitted to any Day Industrial School and shall make such medical examinations and reports as may be required.



8. To the extent and in the form prescribed from time to time by the Board, he shall medically examine the pupils attending the Schools and shall preserve and maintain on approved schedules a record of the examination of each child.

9. He shall organise and superintend such systematic measurements and observations as the Board shall institute or approve,—for example, measurements of height and weight, improvement or deterioration of physique, and the like.

10. He shall from time to time inspect the physical exercises given in the Schools, and shall report to the Board any practices that he considers injurious to individual pupils.

11. If any child is specially reported to him by the Head Teacher as suffering from any ailment or defect or injury, he shall as soon as possible examine the child and give such directions as may be necessary.

12. When required, he shall medically examine candidates appointed to positions under the Board, Junior Students and Intending Junior Students, and report in cases of employees absent owing to illness.

13. He shall, after such examination as he may find necessary, certify the fitness of teachers or pupils to undergo special courses of Physical Training.

14. He shall, by lecture, demonstration, or otherwise, instruct the teachers in the methods of recognising the common ailments and defects of School children; in the practice of first aid for School accidents; in the general hygiene of the School and classroom, and in the physiological principles that underlie physical training.

15. He shall keep such records and books as the Board may prescribe or approve; he shall submit an Annual Report on the work done, and he shall make such special reports as the Board may require.

16. He shall perform any other medical duties that may be, from time to time, required by the Board; but medical or surgical treatment shall be no part of the Medical Officer's duty.

*Adopted by the Board on 17th December 1906.*

LITERATURE.—1. LESLIE MACKENZIE and MATTHEW. *The Medical Inspection of School Children* (Edin. and Glasgow).—2. LESLIE MACKENZIE. *The Health of the School Child*.—3. Report of Royal Commission on Physical Training (Scotland), 1903.—4. Report of Inter-departmental Committee on Physical Deterioration, 1904.—5. Report of the Inter-departmental Committee on Medical Inspection and Feeding of School Children attending Public Elementary Schools, 1905.—6. Report by Dr. W. Leslie Mackenzie and Captain Alan Foster on a Collection of Statistics as to the Physical Condition of Children attending the Public Schools of the School Board for Glasgow, 1907.—7. Report issued by Edinburgh Charity Organisation Society on the Physical Condition of 1400 School Children, together with some account of their Homes and Surroundings (London).—8. Reports on Examination of 1000 Glasgow Children by Dr. A. K. Chalmers and others.—9. Report by Dundee Social Union on 1000 Dundee School Children (Dundee).—10. Annual Reports by Dr. James Kerr, Medical Officer (Education), London County Council.—11. Annual Reports by Medical Officer of Dunfermline Carnegie Trust, 1906 and 1907.—12. Transactions of Nuremberg Congress on School Hygiene, 1904.—13. Transactions of London Congress on School Hygiene, 1907.—14. *International Magazine of School Hygiene*, edited by BRUNTON, JOHANNESSEN, and HERM (Leipzig).—15. Memorandum on Medical Inspection of Children in Public Elementary Schools, under Section 13 of the Education (Administrative Provisions) Act, 1907.—16. General Report on Teaching of School and Personal Hygiene to Students in training in Scotland.—17. See also general works on School Hygiene, particularly *Enzyklopädisches Handbuch der Schulhygiene*, edited by WEHMER (Wien and Leipzig), 1904; and *Handbuch der Schulhygiene*, by BURGERSTEIN and NETOLITZKY (Jena).—18. Report by Dr. Crowley, Bradford, On a Course of Meals given to Necessitous Children from April to July 1907.



**Sensation.**—**AFFERENT NERVOUS SYSTEM.**—One of the most important contributions which have been made to our knowledge of the physiology of the nervous system in recent years is Dr. Henry Head's work on the conduction of sensory impulses in the peripheral nerves and spinal cord. His observations are based on the effects of disease of the nervous system, on the results of nerve injuries, on referred pain in visceral disease, and on the phenomena produced in his own person by division and subsequent suture of a divided nerve.

Broadly, what Head has done is to trace the different forms of sensory impulses through their different paths in the peripheral nerves—the “primary level”—and to show that in the cord—the “secondary level”—the different impulses are redistributed and recombined in different paths; he suggests, further, that in the brain—“tertiary level”—a further redistribution and recombination takes place. For the almost innumerable detailed observations supporting his argument his original papers must be referred to.

*Sensory Peripheral Mechanism.*—There are three sets of sensory impulses:—(1) *Deep sensibility*—sensations of muscular and articular movement, and sensations of deep pressure, the last culminating in pain when the pressure is severe. (2) *Protopathic sensibility*—sensations of painful cutaneous stimuli, and of temperatures below 20° and above 50° C. Protopathic sensations are characterised by the impossibility of accurately localising them. (3) *Epicritic sensibility*—tactile sense in its restricted meaning, *i.e.* the power of appreciating gentle touches, of localising stimuli, of discriminating adjacent compass points, and of distinguishing warmth and coolness between 20° and 50° C. These three sets of impulses travel by different sets of nerves—deep sensibility in the muscular nerves; protopathic sensibility in many of the somatic and visceral afferent nerves; epicritic sensibility in the peripheral cutaneous nerves. All the protopathic fibres from any area converge to the corresponding nerve root, which is, therefore, the *unit of protopathic supply*; the epicritic fibres from an area of skin converge to a peripheral cutaneous nerve, which is therefore the *unit of epicritic supply*.

When a peripheral nerve is divided there is a large area of lessened sensibility, and, within the confines of this, a smaller area of complete anæsthesia. In the latter, of course, both epicritic and protopathic sensibility are abolished; in the former only epicritic sensibility is gone, protopathic is preserved. The area of epicritic anæsthesia has a well-defined margin which corresponds with the distribution of the cutaneous nerve divided; there is no overlap of fibres from adjacent nerves, hence, as has been said, the peripheral nerve is the unit of epicritic supply. The zone of protopathic anæsthesia—*i.e.* the smaller area of complete anæsthesia—has an ill-defined outline, which does not correspond with that of the area of distribution of the peripheral nerve; the difference in the distribution of the epicritic and protopathic anæsthesia is due to overlapping of protopathic fibres from adjacent nerves. If, however, a nerve root, instead of a peripheral nerve trunk, is divided, the areas of epicritic and protopathic anæsthesia coincide, whence it follows that the root is the unit of protopathic supply.

Over the area of partial (*i.e.* epicritic) anæsthesia light touches are not felt, adjacent points are not discriminated, and temperatures between 20° and 30° are not distinguished. Protopathic sensations are preserved: a prick causes indefinitely-localised tingling pain, and only temperatures below 20° or above 50° are described as cold, or hot.



Over the area of complete (*i.e.* epicritic and protopathic) anæsthesia only deep sensibility is preserved.

After suture of a divided nerve the protopathic fibres are the first to be repaired—*i.e.* the analgesic area disappears. The area of epicritic anæsthesia (light touch, and moderate variations in temperature) may persist for months or years. The hyperalgesia which so often succeeds nerve injuries follows the course of the protopathic fibres, and, on account of their wide distribution and overlapping, it greatly exceeds the area of epicritic anæsthesia. Nutritional changes run parallel in extent and duration to the abolition of epicritic sensibility.

*Sensory Spinal Mechanism.*—In the cord the threefold grouping of sensory impulses just described ceases to exist: the groups are dissociated, and redistributed into a group of sensations of pain, a group of sensations of temperature, a group of sensations of touch, and a group of sensations of passive position and movement and discrimination of adjacent points. Instead of the three groups of deep, protopathic, and epicritic, we have four—pain, temperature, tactile, and spacial. Sensations of pain and temperature pass up the side of the cord opposite to their point of entry; they are closely, but not inextricably associated. The group of tactile sensations are also crossed; the group of spacial sensations pass, uncrossed, up the side of the cord at which they enter.

The following scheme represents what occurs:—

#### AFFERENT IMPULSES IN

PERIPHERAL NERVES.		SPINAL CORD.	
Muscular and Articular Nerves.	DEEP SENSIBILITY.	PRESSURE.	Combined Tactile.
	DEEP PAIN.	LIGHT TOUCH.	
	POSITION.	CUTANEOUS LOCALISATION.	
Afferent Branches of a Posterior Root (unit of supply).	PROTOPATHIC.	HEAT AND COLD.	Combined Thermal.
	SUPERFICIAL PAIN.	WARMTH AND COOLNESS.	
Peripheral Cutaneous Nerve (unit of supply).	LIGHT TOUCH.	DEEP PAIN.	Combined Painful.
	CUTANEOUS LOCALISATION.	SUPERFICIAL PAIN.	
	WARMTH AND COOLNESS.	POSITION.	Uncombined.
	DISCRIMINATION OF POINTS.	DISCRIMINATION OF POINTS.	

Opposite side of Cord.

Opposite side of Cord.

Posterior Columns of same side of Cord.

For a detailed proof of the accuracy of these statements, Dr. Head's original observation must be referred to. In general terms, he finds that a cord lesion which abolishes pain, abolishes it entirely—we never have cutaneous analgesia with retention of pain on deep pressure, as occurs when a peripheral nerve is divided. Similarly, when from a cord lesion sensibility to light touch is destroyed so also is sensibility to deep touch; when the temperature sense is affected, both moderate



warmth and coolness, and extremes of temperature, fail of recognition. Further, the loss of sense of position goes hand in hand with the loss of power to discriminate between adjacent points.

The impulses which recombine—thermal, painful, tactile—cross to the opposite side of the cord; the impulses we have grouped as “spacial”—position and tactile discrimination—are less closely related, and do not cross in the cord, but pass up on the long extrinsic fibres of the homolateral posterior columns. Some, or all, ultimately cross at the level of the nucleus gracilis and nucleus cuneatus, but it may be that those which subserve equilibration, and do not overstep the threshold of consciousness, enter the same side of the cerebellum without ever undergoing decussation.

REFERENCES.—HEAD. *Brain*, No. 110, 1905 ; *ibid.*, No. 116, 1907.

## Skin Diseases.

BIER'S HYPERÆMIC TREATMENT . . . . .	421	STAPHYLOCOCCAL VACCINES . . . . .	422
RADIUM TREATMENT . . . . .	422		

BIER'S CONGESTION TREATMENT as used in various surgical conditions is also applicable to skin diseases. It will be found helpful in all acute and chronic suppurative conditions associated with the finger nails, and especially in the chronic indolent perionychia so often seen in delicate strumous children. A piece of lint is wrapped round the base of the finger, and then a thin elastic band applied for one hour night and morning. If any pain is caused it shows that the elastic band is too tight and should be loosened. By applying it to each finger separately better results are obtained than by putting on an elastic bandage higher up the limb. This method of treatment is also very useful in cases of chilblains, acting both on the chilblains themselves and on the pain and itching which are so often associated.

A modification of this method of treatment is the use of a Klapp's cup, which consists of a glass cup like an ordinary cupping-glass connected by an indiarubber tube to an indiarubber ball. The cups are of various sizes. Their chief use is in the treatment of furuncles and carbuncles. The cup, after having its edge smeared with vaseline, is applied over the boil with one hand, whilst the indiarubber ball is squeezed with the other. The indiarubber ball is slowly allowed to expand till the cup adheres. Considerable suction is thus exerted on the diseased area and a local congestion produced. It causes a marked suction of lymph into the part, thus bringing the bactericidal bodies in the serum into better contact with the germs. If applied early over a threatening boil it often aborts it. After the boil has once formed, it acts best after the boil bursts or is incised, causing a much more rapid separation of the core than normal. It should be applied daily in successive short applications of five minutes, with about three minutes' interval between each application, gives better results than one longer continuous application. The total duration of the applications should be about half an hour.

For carbuncles the same method is to be used, and is found, besides having a curative effect, to give great relief from pain. It rapidly controls the spread of the process, and when using Klapp's cup no further incision as a rule is necessary and rapid healing takes place after the slough



separates. Between the applications the boil or carbuncle is kept dressed with the usual boracic poultice.

REFERENCE.—MEYER and SCHMIEDEN. *Bier's Hypercæmic Treatment*, 1908.

**RADIUM TREATMENT OF SKIN DISEASES.**—Radium therapy is still in its infancy, as the quantities of radium as yet available are so small that comparatively few have been able to use it. The chief diseases in which it has been definitely proved to be useful are carcinoma, lupus, and nævi. Its use in the first two diseases has already been referred to. Of the pigmented nævi the flat ones are more amenable to radium than the prominent ones. In vascular nævi, especially the "port-wine stains," excellent cosmetic results are obtained. The treatment is slow and the duration and frequency of the applications must be determined by experiment with any given sample of radium.

**STAPHYLOCOCCAL VACCINES IN SKIN DISEASES.**—In the vaccine therapy of skin diseases no better results have been obtained in any set of diseases than those obtained in staphylococcal infections. Excellent results may be got in carbuncles and boils. As a rule a stock vaccine of staphylococcus aureus or a mixture of aureus and albus does quite well; but occasionally cases are met with which prove rebellious, and it is well in such cases to get a vaccine made from the patients' own organisms.

Injections of 250-500 million staphylococci are given every 14-18 days. It is agreed by nearly all that it is not necessary to have the treatment controlled by estimations of the opsonic index.

Sycosis is another disease where a suitable vaccine is often very successful. Everyone who has seen much of this disease knows how difficult it is to cure the condition. At the Edinburgh Royal Infirmary very good results have been obtained from vaccine treatment, but it is too soon to form a definite opinion as to the permanency of the cures. Local treatment by antiseptic ointments should of course be carried on in addition to the administration of the vaccine.

In acne vulgaris Allen says that the opsonic index to the staphylococcus is consistently below normal, and he recommends the use of a staphylococcal vaccine, beginning with doses of 250 million organisms and increasing up to 750 million, giving injections every 14 to 21 days. As the disease gets better the dose should be gradually diminished and given at longer intervals. As is to be expected, this method of treatment is only beneficial in cases where there is much suppuration, and it has no curative effect on the comedo and other early lesions.

REFERENCE.—ALLEN. *Vaccine Therapy and the Opsonic Method of Treatment*, 1908.

**Sleeping Sickness** (see *Encyclopædia Medica*, Vol. XI. p. 209).—In May 1901 Forde detected in the blood of a man suffering from chronic irregular fever an extra-corpuscular organism, which Dutton identified as a trypanosome, and thus for the first time demonstrated the occurrence of trypanosome infection in man. The observation was confirmed early in 1902 by Manson, who found a similar organism in a patient suffering from irregular pyrexia contracted in the Upper Congo. Dutton had named the parasite *Trypanosoma gambiense*, and the disease to which it gave rise "Trypanosome fever." In December 1902 Castellani observed the trypanosome in the blood of



a sleeping-sickness patient, and in the ensuing year he detected it in the cerebro-spinal fluid of patients suffering from the disease. Dutton and Forde did not associate trypanosomiasis with sleeping sickness, and regarded the organism as a harmless parasite. Manson's patient, referred to above, developed symptoms of sleeping sickness and died in December 1903, and the diagnosis was verified on post-mortem examination by Mott. In March 1903, Colonel Bruce and Dr. Nabarro, subsequently joined by Dr. Greig, arrived in Uganda to study sleeping sickness, and were met there by Castellani's report of his discovery of the trypanosome in the cerebro-spinal fluid. The subsequent work of the Commission, whose report is summarised here, conclusively settled the nature of sleeping sickness.

1. The cerebro-spinal fluid of every case of sleeping sickness taken by lumbar puncture during life contains trypanosomes.
2. Trypanosomes are found in the cerebro-spinal fluid of cases of sleeping sickness occurring outside Uganda.
3. Cerebro-spinal fluid from diseases other than sleeping sickness does not contain trypanosomes.
4. The peripheral blood of all cases of sleeping sickness contains trypanosomes.
5. The trypanosome of sleeping sickness and the trypanosome of trypanosomiasis are probably the same; if confined to the blood they give rise to slight fever, whereas if they reach the cerebro-spinal fluid they cause sleeping sickness. Trypanosome fever is therefore an early stage of sleeping sickness.
6. In an area infected with sleeping sickness a considerable proportion of apparently healthy natives harbour trypanosomes; in non-sleeping sickness areas not a single trypanosome is found.
7. When monkeys are inoculated with the blood or cerebro-spinal fluid from trypanosomiasis or sleeping sickness, they manifest symptoms of the disease, and trypanosomes can be recovered from their blood and cerebro-spinal fluid.

Sleeping sickness was introduced into Uganda from the Congo in 1900 and spread widely round the north shore of Lake Nyanza, being roughly limited to a 20-mile radius round the coast. The distribution, taken along with the nature of the parasite, led the Commission to conjecture that the infection might be conveyed by a biting insect, and on the analogy of Nagana they suspected a tsetse fly. The distribution of a species of tsetse (*glossina palpalis*) was found to correspond with that of the disease. Feeding experiments then showed that the tsetse fly could convey the trypanosome to monkeys.

**DETECTION OF TRYPANOSOMA GAMBIENSE.**—The parasite is present in such small number in the peripheral blood as to render its detection in ordinary smears very difficult. Bruce adopted the method of repeated centrifugalisation, using about 10 c.c. of blood, to detect it. The greatest number of trypanosomes were found as a rule in the sediment of the third centrifugalisation; in this living trypanosomes can usually be seen with a low power. Details of the trypanosome are best brought out by Leishman's stain (*vide* p. 78), which is allowed to act for 10-15 minutes. The macronucleus appears red, the micronucleus black, the flagellum red, and the body protoplasm blue. When once the symptoms of sleeping sickness have developed the parasite is comparatively readily detected in the deposit obtained by centrifuging 10-15 c.c. cerebro-spinal fluid for half an hour. Enlargement of the lymph glands is an early sign of infection, and Greig made the important observation that the organism could be recovered with great ease from a drop of the gland juice removed by a hypodermic syringe.



NATURE OF INFECTION.—The trypanosome is introduced into the blood by the bite of an infected tsetse fly (*glossina palpalis*, and possibly other species), but not by other suctorial flies. It first reaches the lymph glands, causes a general adenitis, and thence enters the general blood and lymph stream. It lives in the fluids of the body, and does not enter the cells. In the later stage of the disease it gains access to the cerebro-spinal fluid. The trypanosome reproduces itself in the body by longitudinal fission. It does not leave the body by any of the natural channels, but is withdrawn by the bite of the tsetse. After one of these flies has fed on an infected subject, trypanosomes can be seen in its proboscis, and at a later period (up to 118 hours) they are still active in its stomach, but after 140 hours no live parasites can be seen. They do not undergo metamorphosis in the glossina, but apparently die, and are excreted by the intestine. The trypanosome rapidly loses its virulence in the glossina, and an animal cannot be infected by the bite of a fly longer than two days after the latter has fed.

*T. gambiense* has not yet been grown on artificial media; it is rapidly destroyed by a temperature of 45° C. Blood containing the organism loses its virulence forty-eight hours after withdrawal from the body. *T. gambiense* is pathogenic to monkeys, cats, dogs, guinea-pigs, rats, mice, and rabbits, but on the whole the disease is more chronic than in man; sheep, horses, and cattle are very slightly susceptible.

It was believed (on the analogy of what obtains in Nagana) that the game in a sleeping-sickness district harboured the trypanosome, and that the tsetse fly conveyed it from them to patients as well as from man to man. Koch has recently ascribed special importance to crocodiles as reservoirs of trypanosome infection. According to the Ninth Report of the Sleeping Sickness Commission of the Royal Society, however, there is no ground for supposing such to be the case.

There is reason to suppose that in man a second phase in the development of the trypanosome occurs, and a special line of treatment is based on this supposition (*vide infra*).

SYMPTOMS.—The symptoms of the disease were well known before its cause was discovered, but since the parasite has been recognised it has become possible to make the diagnosis before the characteristic symptoms develop. After the organism enters the body a considerable time elapses before it gains access to the cerebro-spinal fluid. Bruce puts this period at from three months to three years, and the chief symptoms during this the first stage of the disease are polyadenitis with early affection of the post-cervical glands, and in some cases irregular pyrexia. At this stage there are no other symptoms, and the lassitude characteristic of developed sleeping sickness is very insidious in its onset.

TREATMENT.—So far as is known trypanosomiasis is invariably fatal in man, though there is reason to hope that in the near future a remedy will be found. The remedies which appear to be most effective in checking the disease are arsenic, mercury, and trypan-red. These act by destroying the organism. Arsenic is now generally given in the form of atoxyl (see p. 153), which is administered intramuscularly in 5-10 per cent. solution. The initial daily dose may be .2 gram of the drug, increasing by .05 gram daily until .8 gram is being given. If there are no toxic symptoms, this dose may be maintained for a fortnight,



when the drug is gradually discontinued in the same manner as it was begun. Three or more such courses, at intervals of a few months, are advised. The dose of trypan-red is 5 grains; it may be given along or alternating with the atoxyl. Balfour reports favourably on the trypanocidal action of chrysoidine in doses of  $\frac{1}{2}$  grain daily.

Some interesting work in experimental therapeutics must also be referred to. Ehrlich finds that in animals trypanosomes may be caused to disappear temporarily by the administration of para-fuchsin; after an interval the parasites are again found, and can again be banished by a second course of treatment. As time goes on, however, the trypanosomes are found to be less and less affected by the drug, which finally loses its effect. The trypanosomes have acquired immunity to it—have become “fuchsin-fast.” Such fuchsin-fast strains of trypanosome (a) retain their immunity to fuchsin when injected into a second animal, (b) transmit their immunity through many generations (over a hundred, at least), but (c) are not immune to other trypanocidal drugs. In the same way “atoxyl-fast” and “trypan-red-fast” strains can be produced. These observations point to the advisability of giving trypanocidal drugs in large doses as early as possible instead of small doses spread over a longer time. It would also seem desirable to change the remedies used, as resistant strains may develop, and a remedy which proved efficacious when first administered may cease to have any trypanocidal action.

What promises to be a distinct advance in the treatment not only of trypanosomiasis, but of protozoal diseases generally, has been made by Moore, Nierenstein, and Todd. The principle underlying the method they recommend is that when an infecting organism shows two distinct phases in its life history, these two phases ought to be attacked by two different drugs, for it is probable that a drug which is operative against the first will be inoperative against the second, and *vice versa*. These workers found (a) that one or two large doses of atoxyl drive the parasites from the blood of rats (*trypanosoma brucei* infection), but that fatal relapse is invariable; (b) that mercury alone has no effect on the trypanosomes ordinarily met with in the blood, but (c) that if rats infected with *t. brucei* have the parasite first expelled from the blood by atoxyl, and then receive injections of perchloride or iodide of mercury, a considerable number recover completely. Of 25 rats so dealt with, 2 died from trypanosomiasis, 4 died from other causes, 2 were killed and gave no evidence of infection, 17 survived (68 per cent.). The results of this combined treatment of sleeping sickness in man are, of course, still *sub judice*, but Boyce states that they are distinctly encouraging.

PROPHYLACTIC MEASURES.—Reports from Uganda seem to render the prospect of controlling sleeping sickness brighter than we have hitherto dared to believe. It seems that the distribution of *glossina* is peculiarly limited. The favourite natural habitat of the fly is near open water, with definite banks shaded by scrub and underwood. It does not infest swamps. The natural range of the fly is limited to a belt from 10 to 30 yards broad along the water edge, and it does not leave this area except when following, and feeding on, its victim. Even its “following range” does not seem at the outside to exceed 300 yards, and is usually less. Tsetse fly does not cross an artificial clearing 25 or 30 yards wide made in a natural fly belt. The chief prophylactic measures which are about to be tried, or have to some extent been



enforced, in Uganda are—(1) Clearance of areas 30 yards broad along such portions of the lakeside, at fords, and other places frequented by natives. (2) Segregation of infected persons outside a fly area, so that flies may not act as carriers from them. (3) Provision of clothing for natives who are compelled to work in fly areas. (4) Prolonged treatment with atoxyl.

LITERATURE.—FORDE. *Journ. Trop. Med.*, 1st Sept. 1902.—DUTTON. *Thomson-Yale Laboratory Reports*, vol. iv. 1902.—CASTELLANI. *Journ. Trop. Med.*, 1st June 1903.—Report on Sleeping Sickness (BRUCE, NABARRO, and GREIG). *Brit. Med. Journ.*, 21st Nov. 1903.—EHRlich and SHIGA. *Berl. klin. Wochensch.*, 28th March, 4th April, 1904.—MOTT. *Brit. Med. Journ.*, 13th April 1904; *ibid.*, 21st Dec. 1906.—EHRlich. *Berl. klin. Wochensch.*, Nos. 9-12, 1907.—MOORE, NIERENSTEIN, and TODD. *Biochemical Journ.*, vol. ii. p. 300, 1907.—BOYCE. *Brit. Med. Journ.*, 14th Sept. 1907.—BALFOUR. *Second Report of Wellcome Research Laboratories* (Khartoum), 1906.—*Reports of the Sleeping Sickness Commission of the Royal Society* (London: Stationery Office), Nos. 1 to 9 (No. 9 contains a general index to the whole series).

**Spasmophile Diathesis.**—This name has been used by Heubner, Thiemich, Finkelstein and others to describe a very common affection of infancy, namely, that which is characterised by increased mechanical and electrical irritability of the peripheral nerves, by laryngismus, by convulsions, and by tetany. These four nervous manifestations are, as is well known, often associated with rickets. They are not, however, due to rickets, but are probably induced by the same kind of dietetic errors as tend to cause that disease.

The clinical features of infantile convulsions, laryngismus, and tetany, have been described under these heads in the *Encyclopædia Medica*. Increased mechanical irritability of the peripheral nerves is most easily detected by tapping the cheek below, and a little in front of, the ear, whereupon, if it is present, a rapid twitch of the muscles about the angle of the mouth occurs. In well-marked cases almost any muscle in the body can be stimulated to contract in the same rapid way by tapping in the neighbourhood of its motor point. Increased mechanical irritability can be especially easily demonstrated in the biceps, extensors of the forearm, quadriceps, pectorals, and calf muscles. Facial irritability as described above (Chvostek's sign) must not be confused with the lip-reflex, a phenomenon described by Thomson (*Rev. Neur. and Psychiatry*, March 1903) and others. The lip-reflex consists of a pouting movement of the lips, which is produced in young infants by tapping near the angle of the mouth. It can rarely be elicited except during sleep, and is a normal phenomenon in the newly born, but tends to disappear about the third year. The lip-reflex is a quasi-purposive, co-ordinated movement, and both sides of the mouth pout in response to unilateral stimulation. Repetition of the taps has a cumulative effect on the movement of the lips.

In children who suffer from spasmophilia there is hyper-excitability of the nerves to galvanic stimuli, and the detection of this is held to justify the diagnosis even if neither tetany, eclampsia, laryngismus, nor facial irritability is present ("latent tetany"). Thiemich gives the following table of reactions. The values are in milliampères. The indifferent electrode (50 sq. cm.) was placed on the chest, and a Stinzing normal electrode (3 sq. cm.) was used as the active one. The median nerve at the bend of the elbow was tested.



	K.C.C.	A.C.C.	A.O.C.	K.O.C.
Average normal child. . . .	1.41	2.24	3.63	8.22
Manifest tetany . . . .	0.63	1.11	0.55	1.94
Latent tetany . . . .	0.70	1.15	0.95	2.23
Previous tetany . . . .	1.83	1.72	> 2.3	> 7.9

The K.O.C. reaction is the most important. Values below 5.0 ma. are pathological, while values above 5.0 ma. are normal.

ETIOLOGY OF SPASMOPHILIA.—The cause of the spasmophile diathesis is not properly understood. It is very often associated with rickets, and is most common in the colder months of the year, especially the early spring. The symptoms are liable to be induced by two different faults in diet—the prolonged use of farinaceous food, and over-feeding with cow's milk. It is found, accordingly, that children with the spasmophile diathesis fall into two groups—the large, obese, over-fed infants, and the puny, ill-nourished, dyspeptic ones. The former are usually much more amenable to treatment than the latter. Spasmophilia is rare in breast-fed children; when it does occur in them it seems to be associated, in many cases at least, with over-feeding. Thiemich attaches great importance to a hereditary tendency which shows itself both by direct transmission of the diathesis from mother to child, and by the occurrence of several cases in a family.

Finkelstein, endeavouring to ascertain which constituent of milk was harmful, concluded that the whey must be blamed. It is most probable that the disease is in some way connected with faulty calcium metabolism. Here again there are two opposing theories: on the one hand Stoelzner asserts that it is a sort of calcium poisoning, while Guest, Sabbatani, and others believe that the tissues are suffering from calcium starvation. More recently attempts have been made to show that tetany, at least, is due to disturbance of parathyroid function by hæmorrhage into the glands (Yanase, Escherich), and MacCallum's work suggests that animals suffering from tetany following parathyroidectomy are in a condition of calcium starvation. On the whole, the majority of observations point in the direction of there being deficit, rather than excess, of calcium in the tissues, and Stoelzner's theory has few supporters. (See also PARATHYROIDIS.)

TREATMENT.—The first step is to correct any digestive disturbance which may be present, and for this purpose a dose of castor oil, followed by powders containing a grain of grey powder, half a grain of rhubarb, and a few grains of sodium bicarbonate, may be given. Next, the diet requires attention. Breast milk is best, if it can be obtained. Failing this, the diet selected will depend on the previous feeding, and on the nutrition of the child. In obese, over-fed babies, which have habitually consumed excessive quantities of milk, the diet should be restricted for a day or two to a cereal decoction such as barley or rice water, and then limited to carbohydrates (Mellin's or Savory & Moore's food) for four or five days longer. At the end of this time milk is cautiously added. The chief point is to avoid over-feeding. In ill-nourished children the indication is to fatten the patient; if the diet has previously consisted of carbohydrate the indication is to fatten the child; if his diet has contained an excess of carbohydrates this should be diminished, replaced by milk. Cod liver oil should also be given. If the convulsions are severe and recur frequently a sedative is



required. Chloral (i.-ii. grs.) and antipyrin (gr. i.) are more useful than bromides. Phosphorus and cod liver oil (1:10,000) is extolled by Finkelstein.

Cold douches are most useful in checking the tendency to convulsions. After the infant has had his bath one or two spongefuls of cold water are squeezed over the neck and spine, and then the body is quickly dried with a warm towel. Douching in this way is often very effectual in curing the manifestations of spasmophilia.

The prognosis is not unfavourable; most cases recover. It is worst in poorly-nourished infants, and in cases in which there is much laryngismus. Children suffering from the spasmophile diathesis have less resistance than healthy ones, and if by chance they contract pneumonia or bronchitis matters often go hardly with them.

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**Spondylose Rhizomélique** (SPINAL RIGIDITY).—The name *spondylose rhizomélique* was applied by Marie to a particular group of cases of spinal rigidity to demarcate them from other cases in which the same symptom is a leading feature.

The general symptoms of this, and other forms of spondylitis, are, rigidity of the spinal column, either throughout its whole length, or in part, and in some cases ankylosis of the larger joints of the extremities. The rigidity of the spine may be so great as to abolish entirely all movement—lateral, antero-posterior, or rotary; there is generally, but not always, well-marked kyphosis of the cervico-dorsal region. In the type described by Marie as rhizomelic spondylosis there is ankylosis of the spine and of the hip and shoulder joints, and sometimes of the ribs, leading to flattening of the chest and an abdominal type of respiration. The lesions resemble those of osteo-arthritis. There is no affection of the cord. In another form of spinal rigidity, previously described by Bechterew, the ankylosis is limited to the upper part of the vertebral column, and there is thickening of the cervico-dorsal meninges, causing atrophy of the spinal ganglia and degeneration of the nerve roots and posterior columns. The onset of this type is sudden; there is a hereditary predisposition, and often a trauma. For these reasons it is known as Bechterew's heredo-traumatic kyphosis. In addition to the spinal rigidity it is characterised by the existence of nervous symptoms—pain, paræsthesiæ, a wasting of muscles. Bechterew regards the cord lesion as the primary event.

There is much reason to doubt whether the two types sketched above are really so distinct from each other as to justify their description under separate names. Mixed forms have been described by Gordon and others—*e.g.* rigidity of the entire spine with joint involvement plus signs of cord lesion. Hunter recognises four groups of cases of rigidity of the spine (spondylosis). 1. Rheumatoid arthritis, in which there is ankylosis of other joints with osteophytes, generalised atrophy of muscles, fibrillary twitching, and sensory disturbance—in short, the features characteristic of rheumatoid arthritis. The onset is gradual; the disease begins either in the limb or spine. 2. Spondylosis following repeated attacks of rheumatism, or gonorrhœa. The spine is rigid; the ankylosis of the joints elsewhere is fibrous rather than osseous;



there are no osteophytes (Marie's type). 3. Cases arising from a trauma, such as a fall on the buttocks or shoulder. There is no evidence of direct injury to the spine at the time of the accident, but some weeks later ankylosis begins (Bechterew's type). 4. Senile ankylosis in old people whose occupations have necessitated much stooping. A. E. Garrod doubts whether the several types described should be classed as separate maladies. He gives considerable prominence to the nerve-root symptoms in the clinical picture of the disease, but states that the manner in which pressure on the roots occurs requires further elucidation.

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**Stomach, Acute Dilatation of the.**—Acute dilatation of the stomach is a rare occurrence. It has been ascribed to sudden paralysis of the vagus, but is probably in most cases due to obstruction of the duodenum, and a knowledge of the mechanism by which it is brought about is important, because if the condition is properly treated many cases which would otherwise die may recover completely. The symptoms of acute dilatation are sudden vomiting accompanied by intense pain, marked abdominal distension, chiefly in the epigastric region, and collapse. The vomit is copious, and usually bile-stained, seldom feculent. There may be splashing sounds in the epigastrium, but visible peristalsis is rare. Death occurs in from a few hours to two days unless the condition is relieved. In a series of 102 cases collected by Conner the mortality was over 70 per cent. Acute dilatation is favoured by several groups of antecedent circumstances:—(1) Operations (not necessarily abdominal) under general anæsthesia. (2) Wasting diseases, or convalescence from an acute illness. (3) Injuries of the spine. (4) Excess in eating or drinking, especially copious draughts of cold fluids. (5) Spinal deformities. It sometimes occurs without any apparent cause in healthy persons. Nearly half of Conner's series of cases followed operation. It seems that the most important cause of acute dilatation is incarceration of the duodenum between the root of the mesentery in front and the spinal column behind. Normally, the terminal part of the duodenum is slightly flattened between the mesentery and the vertebral column, and if from any cause the small intestine is pulled down and backwards, towards the pelvis, the gut may be occluded. Acute dilatation is therefore rendered possible by such conditions as (a) favour compression against the spine—*e.g.* lordosis of the lumbar vertebræ—and (b) facilitate the descent of the small intestine into the pelvis. In order that the latter may take place the mesentery must be long, the intestines must be empty (as after an operation), and the patient must be lying on his back. The possibility of the occurrence of chronic duodenal obstruction by the mesentery is suggested by Codman. He thinks it may cause duodenal stasis, and hunger pain.

The treatment for acute dilatation must be prompt. The stomach should be washed out and the patient placed in the genupectoral position and kept in that attitude for several hours, so as to facilitate the return of the prolapsed small intestine from the pelvis. Smith reports a case which was cured by turning the patient over on the abdomen and raising the foot of the bed 12 inches. A high enema was also given.



The patient responded quickly to this treatment, which has obvious advantages over the prolonged maintenance of the knee-elbow position.

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**Symphysiotomy and Pubiotomy.**

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OF late years much has been heard of symphysiotomy and allied procedures in cases of contracted pelvis; but even a superficial examination of the great mass of literature which has grown up round the subject will reveal the fact that it is mainly Continental, and only to a small extent British or American. There have been symphysiotomists, both in Great Britain and in America, and some of them (*e.g.* Herman, Munro Kerr, and Buist) have been able to report numbers of successful cases with no maternal mortality; the subject of pelvic section, also, has been debated, often and thoroughly, both in the medical and obstetrical societies of this country and of the United States; but, whilst all this is true, it cannot be said that the operation itself has assumed the importance given to it in France, Italy, and Germany, and it must be freely admitted that at present it is losing and not gaining ground. Possibly this is in part at least to be explained by the dislike to the induction of premature labour which our Continental brethren seem to have; and no doubt it is largely to be accounted for by the repugnance to cutting operations in midwifery exhibited by both the profession and the public in this country. That there is a very sharp line of cleavage between Continental and British obstetric practice in respect to symphysiotomy, hebotomy, and pubiotomy may be learned from the study of what Professor Schauta (*Journ. Obstet. and Gynaec. Brit. Emp.*, xv. p. 318, 1909) has said regarding the management of labour in a contracted pelvis, although perhaps we ought to regard his views as those of the more extreme German school. Schauta is of opinion that “the management of labour in contracted pelvis will shape itself in the future in the following simple manner, provided it is carried out from the very commencement in a skilful manner and in an institution under strict asepsis. In cases with a conjugate above 8 cm. there is a possibility of spontaneous birth, and therefore expectant treatment is to be adopted. In cases under 8 cm. Cæsarean section is to be kept in view. In cases bordering on the above, that is a conjugate of 8½ to 7½ cm., hebstoeotomy is to be considered. . . . This method of treatment should be looked upon in the future as typical. All other methods hitherto used in the treatment of labour in contracted pelvis should be looked upon as atypical.” When it is borne in the mind that the atypical methods of treatment to which Schauta refers include craniotomy on the dead as well as on the living child and the induction of premature labour, and that he says that “the application of forceps above the brim and prophylactic turning should, if possible, be entirely removed from the list,” it will be evident at once how far distant German obstetric theory and practice have removed themselves from British and American. Schauta speaks of the time in the future when the rules he has laid down shall



be generally adopted as the "golden age of the treatment of labour in contracted pelvis"; and, truly, if the ideal method of dealing with difficult labours is to be by section (abdominal or pelvic) rather than by dilatation, and if the obstetrician of the next generation is to choose the knife rather than the forceps, we may join with him in looking for such an age, but with less enthusiasm in the outlook. In the meantime there are at least two circumstances which militate against any such wholesale adoption of the cutting procedures, two conditions which Schauta admits must be fulfilled before symphysiotomy or Cæsarean section can be performed, viz. "the patient must reach the expert in an absolutely aseptic condition without any obstetrical interference of any kind having been made," and the consent of the patient must be obtained. Schauta seems to doubt whether the patient has any right to refuse, and says that she claims no such right in the case of gynecological operations; but, again, if this be so, it simply demonstrates the deep-seated differences which exist between Continental and British practice.

The *method* of enlarging the pelvic capacity now commonly employed differs considerably from that in use when the article on SYMPHYSIOTOMY appeared in the *Encyclopædia Medica* (Vol. VIII. p. 534, 1901). At that time symphysiotomy, in the strict sense of the term, was going out of favour; it had been introduced and recommended with extraordinary fervour, but the first enthusiasm had subsided, its difficulties were recognised, its limitations were defined, its dangers were known and its inconvenient after-effects had been experienced; the circumstances were propitious for the advent of a new method, and the new method came, division of the bone (hebotomy, pubiotomy, pelvitomy, or hebotomy) taking the place of division of the joint (symphysiotomy).

As early as 1902 there were signs of the coming change. Zweifel (*Centralb. f. Gynäk.*, xxvi. p. 321, 1902) admitted that there was serious opposition to symphysiotomy in Germany based upon its dangers, and thought that these might be lessened by drainage with tubes and *per vaginam* of the prevesical space (cavum Retzii). Ayers (*Amer. Journ. Obstet.*, xxxvi. p. 1, 1897; *New York Med. Journ.*, lxxv. p. 629, 1902), who had introduced the subcutaneous method of performing symphysiotomy, was able thereby to report good results, but he allowed that the growing prejudice against the operation was founded upon dangers which really existed. Buist (*Journ. Obstet. and Gynæc. Brit. Emp.*, ii. p. 32, 1902), who used Ayers's subcutaneous method, showed that the operation of division of the symphysis pubis could be carried out in domestic practice and so made more generally applicable; but in the same year Sandstein (*Trans. Edin. Obstet. Soc.*, xxvii. p. 68, 1902) published his experimental study of the pelvic changes produced by separation of the pubic bones in symphysiotomy, which demonstrated that the increase in pelvic capacity was due more to the movement downwards than to the rotation outward, that a separation of 6 cm. was all that could be safely allowed, and that the gain in the antero-posterior diameter thus obtained was only 1 cm., and that, therefore, the indications for the operation were somewhat narrow, while its dangers were real. Tissier's observations on the after histories of patients upon whom symphysiotomy had been performed were far from encouraging (*Bull. Soc. d'obstét. de Paris*, 19th Feb. 1903). Interest in symphysiotomy was greatly lessened, and the first wave of enthusiasm had passed, so that, as Munro Kerr has put it (*Operative Midwifery*, p. 375, 1908), "it



appeared as if history were going to repeat itself, and the operation were again to be forgotten."

In 1903, however, interest in pelvic section was again aroused by the proposal of Gigli (*Centralb. f. Gynäk.*, xxvi. p. 1298, 1902; *Bull. Soc. d'obstét. de Paris*, vi. p. 68, 1903) and of Van de Velde (*Centralb. f. Gynäk.*, xxvii. p. 969, 1902; *Nederl. Tijdschr. v. Geneesk.*, 2 R. xxxix. d. 1, p. 1303, 1903; *Wien. klin. Wochenschr.*, xiv. p. 847, 1903) to divide not the joint but the bone of the pelvis, to perform what is now known as hebotomy, pubiotomy, pubotomy, hebosteotomy, lateral section of the pubes, ischio-pubiotomy, lateral pelvitomy, or extramedian symphysiotomy. Gigli, indeed, had proposed section of the pubic bone in 1893, and had invented the flexible wire saw named after him (*Ann. di ostet. e ginec.*, xv. p. 557, 1893; xvi. p. 649, 1894), and Bonardi (in 1897), Calderini (in 1899), Van de Velde (in 1901), and Gigli himself (in 1902) had carried out the procedure successfully; but with regard to the first suggestion of the operation we have to go as far back as 1786, when John Aitken of Edinburgh (*Principles of Midwifery*, 3rd ed., p. 83) proposed "sawing through the two rami of the ischium and those of the pubis on either side of the pubic bone." Stolz also described the operation in 1844. Since 1903 a great mass of literature has gathered round pubiotomy, how great may be in part estimated from the fact that the *Zentralblatt für Gynäkologie* for the year 1907 contained eleven original articles on hebosteotomy and between thirty and forty references to articles occurring in other journals. It is unnecessary, however, to consider in detail the many contributions that have been made to the subject, for most of them are concerned with details which are hardly of the importance that the writers of the articles give to them.

The chief methods of performing hebotomy may be briefly described. The ordinary preparations are made and the skin over the symphysis, external genitals, and neighbourhood is rendered as nearly aseptic as possible. If *Gigli's plan* be adopted, an incision is made over the pubes and the soft parts are cut through down to the bone; the cut begins a very little to the left of the middle line and runs downwards and outwards obliquely down to the subpubic tubercle about half-way down the pubic arch. A carrier is then passed behind the pubic bone and the Gigli saw is drawn by it into position; the bone is quickly sawn through, and, as Gigli has said, the pelvis "opens like a book." The infant is usually delivered by forceps, or, in some cases, the natural efforts are waited for. *Van de Velde's method* differs slightly. The incision in the skin is made from the left pubic spine passing downwards and inwards to the outer surface of the left labium majus opposite the vestibule. The operator's finger is introduced at the lower end of the wound thus produced and is pushed below and behind the pubic bone; a curved, blunt-pointed needle, with a slot eye, is then guided up behind the bone (the point being kept close to the bone by manipulation of the handle) until it reaches the upper angle of the wound; the ring of Gigli's saw is then fixed to the needle which is withdrawn so as to bring the saw in contact with the posterior surface of the pubic bone; a few strokes of the saw cut through the bone; and the instrument is now withdrawn from the lower end of the wound and pressure applied to check the hæmorrhage. The child can then be delivered. It is claimed that by following Van de Velde's line of incision the internal pudic artery and the corpus cavernosum of the



clitoris are less likely to be injured. *Döderlein's method* (*Arch. f. Gynaek.*, lxxii. p. 275, 1904; *Zentralb. f. Gynäk.*, xxviii. p. 1240, 1904; xxx. p. 84, 1906) has certain advantages. A colpeurynter is passed into the vagina to dilate the parts, to keep the membranes intact, and to prevent the head coming into the brim. When the cervix is fully dilated the membranes are ruptured, the bladder is emptied, and the section of the bone is carried out. A small transverse incision is made over the pubic bone between the symphysis and the spine, generally on the left side. The finger is passed into the incision and is directed downwards behind the pubes, separating the parts from the bone; then, the way having been prepared, Döderlein's curved needle is carried down along the back of the bone, which it is made to hug closely, until it can be felt under the skin of the labium majus free of the lower margin of the bone; a cut sets the point of the needle free, Gigli's saw is attached to it and is drawn up along the wound until it is in position, and then the bone can be cut through with six or ten strokes (keeping the saw vertical). At this stage the patient is in the dorsal position, and assistants press the pelvis together, although there is no great risk of the two segments suddenly flying apart; hæmorrhage is controlled by pressure as a rule; and now the legs of the patient are allowed to hang down (Walcher's position), and spontaneous delivery is waited for or, if necessary, the forceps is applied. After the placenta has been expelled the vagina is tightly plugged with gauze and compresses are placed over the wounds. In this way hæmatoma, a troublesome complication, may be avoided. The plugging is removed in eight hours, and the bladder emptied. Adhesive plaster and a tight binder close the wounds and hold the pelvis together. Rest in the dorsal position for twelve days is necessary; thereafter the patient usually recovers as after an ordinary delivery (Gibson, *Journ. Obstet. and Gynec. Brit. Emp.*, xi. p. 380, 1907). *Bumm's method* is somewhat similar; as described by Kroemer (*Berl. klin. Wochens.*, xlv. p. 1044, 1908) it is as follows. A Bumm needle is passed in below the symphysis till it touches the bone; it is passed up with its point keeping in contact with the posterior surface of the pubic bone; it is brought out through the skin above the symphysis, close to the middle line; the Gigli saw is led along the passage thus made, and the bone divided with it from above downwards and outwards. It is the usual practice in Bumm's clinique to allow the labour to proceed naturally, unless there are special reasons for haste, and then forceps or version is employed. Bumm's method is practically subcutaneous, and Döderlein's nearly so. There seems to be a general tendency to adopt the latter plan, and so to get rid of long open incisions (Henkel, *Zentralb. f. Gynäk.*, xxx. p. 233, 1906). Various needles or carriers have been suggested, such as de Lee's (*Obstetrics* for 1906, p. 190), Seeligmann's (which is grooved, vide *Zentralb. f. Gynäk.*, xxix. p. 1206, 1905), and Walcher's (*ibid.*, xxix. p. 1102, 1905). In most of them the needle is used to pull the Gigli saw into the wound, but if Seeligmann's (which is hollow and grooved) be employed the sawing can be carried out with the needle in position. It is difficult to express a preference; probably the operator will be advised to use a needle with which he is familiar. Berry Hart (*Trans. Edin. Obstet. Soc.*, xxix. p. 109, 1904) used a large sinus probe with an eye in it.

Whilst there is still much discussion going on in current literature regarding the best method of performing pubiotomy, the most important matter for decision is whether the operation is to be preferred to



symphysiotomy. The following advantages are commonly claimed for hebosteotomy or pubiotomy. It is said to be easier and to be capable of being more rapidly performed, and this would seem to be correct if the operator has taken care to study the topography of the pubic region (see Tandler and Sellheim's articles, *Zentralb. f. Gynäk.*, xxix. pp. 889, 1097, 1905). The natural supports of the bladder, urethra, and vaginal walls are less interfered with than in symphysiotomy, and extension of the operation wound into the vagina is less likely to occur. It has also been affirmed that there is less risk of hæmorrhage; but there is much difference of opinion upon this point, Rosthorn having lost a patient from bleeding (see Williams's *Obstetrics*, p. 459, 1908), and Jessen (*Zentralb. f. Gynäk.*, xxx. p. 252, 1906) having had to finish by doing symphysiotomy after having begun a hebotomy. The wound does not communicate with the vagina, and the operation can therefore be performed in septic cases with less risk of general infection; unfortunately, however, tears communicating with the vagina may occur. It is claimed that a section through bone heals more quickly, safely, and thoroughly than one through a joint; but it must be remembered in accepting this advantage that the symphysis pubis is not an easily infected joint like the knee. The pelvis is said to be permanently enlarged after pubiotomy (Sellheim, *Monatssch. f. Geburtsh. u. Gynäk.*, xxiii. p. 362, 1906), and there is evidence that subsequent labours have been easier, but, of course, it would have to be clearly shown that the size and shape of the foetal head were the same in the cases which are thus contrasted. The urethra is not so apt to be wounded in pubiotomy, and the bladder is less likely to be injured; but whilst this is true of the time when the section is being made, it is not so certainly true of the extraction period (Bar, *Bull. Soc. d'obstét. de Paris*, viii. p. 76, 1905). It is claimed that the mortality is less with pubiotomy than symphysiotomy; but this can hardly be regarded yet as an established fact. Carefully selected cases may show little or no maternal mortality, but when large numbers are considered it may be as high as 5·6 per cent. (Maier, *Diss. inaug.* (Tübingen), 1907). The dangers from hæmorrhage, septic infection of the wound, lacerations or perforations of the bladder and urethra, and subsequent vulvar and vaginal hæmatomata are real; among the earliest cases there were two deaths from sepsis (Baumm, *Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 632, 1903), and one from the late effects of chloroform apparently (Berry Hart, *loc. cit.*), and there have been fatal terminations from hæmorrhage and other causes (Hammerschlag, *Zentralb. f. Gynäk.*, xxxi. p. 1001, 1907); and Seitz (*Münch. med. Wochensch.*, liii. p. 1993, 1906) is of opinion that it is much better to publish the dangers of the operation and its drawbacks than to be loud in its praises, and does not think that pubiotomy is yet to be recommended to the general practitioner.

Before the future of this operation is forecasted, reference may be made to what has been called prophylactic pubiotomy, *i.e.* section of the pubic bone performed during the pregnancy of a patient suffering from pelvic contraction. It is claimed that in this way the woman is saved from the double strain of labour and a serious operative procedure, and that the injuries have time to heal before labour comes on. Gauss (*Zentralb. f. Gynäk.*, xxxi. p. 857, 1907) thinks that the operation should not be done earlier than the thirty-fifth week of pregnancy; and he reports the case of a primipara of 19 years, whose pelvis was generally contracted with a conjugata vera of between 7·4 and 7·9 cm.,



upon whom he performed pubiotomy (by the open method) at the ninth month ; she was delivered spontaneously of a living child, weighing 3000 grams at the full term. It is doubtful if this prophylactic procedure will commend itself to many obstetricians but it is an interesting development, pointing, as it does, to a desire for earlier recognition of such pelvic contractions as may be expected to lead to difficult parturition. It may be added that hebotomy has been performed at least once (by R. H. Pomeroy) for impaction of the breech in a justo-minor pelvis (*Amer. Journ. Obstet.*, lvii. p. 511, 1908), surely a very exceptional indication.

In endeavouring to estimate the future of pubiotomy, it will be well to neglect the views at present being expressed in Germany, and take those of such an American obstetrician as Whitridge Williams. This author, while favourably disposed towards the operation, is critical, and would restrict the employment of the operation in various ways (*Obstetrics*, p. 459, 1908). "Pubiotomy is not indicated in cases in which the conjugata vera measures less than 7 cms. Accordingly, it scarcely enters into competition with Cæsarean section, except for the broadened relative indication. . . . I feel that one may look forward to pubiotomy practically displacing Cæsarean section in the so-called 'border-line' cases, as it enables one to subject the patient to the test of labour and to operate after several hours of second-stage pains have demonstrated that the head cannot pass through the superior strait. Pubiotomy can be safely performed under such circumstances, while in Cæsarean section the prognosis becomes progressively worse the later in labour it is performed. If the future substantiates these views, pubiotomy will still further narrow the field for the induction of premature labour, and practically do away with the use of high forceps, version, or craniotomy in moderate degrees of contracted pelvis when the mother is in good condition. It is also indicated in certain cases in funnel-shaped pelvis, and possibly in face presentations when the chin has rotated into the hollow of the sacrum. . . . I do not believe that the operation should be undertaken when signs of infection are present, as the interests of the mother will be better served by craniotomy, or Cæsarean section followed by removal of the uterus. For the present, at least, I feel that the employment of pubiotomy should be limited to well-equipped hospitals or the practice of experts, since four well-trained assistants are necessary to its proper performance, and, moreover, serious complications may occur at any time, which will seriously tax the resources of even a competent surgeon." Williams's estimate may be taken as a fair one in respect, at any rate, to British and American opinion; and one cannot help thinking that little will be heard of pubiotomy in five years' time. Cæsarean section meets the requirements of high degrees of pelvic contraction, and the last word has not yet been spoken in favour of the induction of premature labour in the moderate degrees.

## Syphilis.

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ETIOLOGY.—On 17th May 1905 Schaudinn and Hoffmann communicated to the Medical Society of Berlin their discovery of a



spirochæte (*spirochæte pallida*) in syphilitic lesions, and thus solved the problem of the etiology of syphilis. In the early part of the same year Siegel had described a protozoon-like organism as the cause of the disease (*cytorrhycles luis*); and although the correctness of his observations was soon disproved, it was their publication which induced Schaudinn, a protozoologist of established reputation, to study the subject. It is also a matter of historic interest that, although the whole credit of the discovery rests with Schaudinn, it was by the merest accident that he was not anticipated by Bordet and Gengon. Two years before Schaudinn described his spirochæte, they had found a spirillum (in all probability the spirochæte pallida) in smears from a hard chancre, but did not appreciate the significance of their discovery; and Metchnikoff, failing either to verify their observation, or to find such spirilla in the experimental syphilis in apes at which he was then working, declared against syphilis being a spirillosis.

Very shortly after Schaudinn's account of his work, Metchnikoff reported that he had found in his infected monkeys a spirochæte resembling (and soon identified by Schaudinn as identical with) the new organism. Thus within a few days two important facts were made public, and very quickly a further link in the chain of evidence was furnished by Buschke and Fischer, who demonstrated the spirochæte in the organs of a congenital syphilitic infant, and by Levaditi, who detected it in the bullæ of congenital syphilitic pemphigus. In the former site, at least, a saprophytic parasite was unlikely to occur. Since that time observations all over the world have led to the same results. The spirochæte pallida is found in the primary sore, in the enlarged glands, in the secondary lesions, in the blood stream—and it has never been found except in syphilis. It has been found in the saliva, in the urine, in the ovaries, but not in the cerebro-spinal fluid, nor, curiously, in the semen. It has even been detected in the tertiary lesions, but not in the parasyphilitic group of diseases, such as tabo-paralysis. It is abundant in all the organs of syphilitic fetuses; in the umbilical cord; in the placenta.

Schaudinn has differentiated the varieties of spirochæte which occur in healthy and diseased genital organs. He has shown that there are two—the *spirochæte refringens*, a normal saprophyte, and *spirochæte pallida*, in syphilis only.

*Spirochæte Pallida*.—A very delicate spiral organism, averaging 6 to 16  $\mu$  long; smaller and larger individuals are also met with. It consists of from 6 to 26 delicate spiral undulations, each measuring from  $\cdot 8$  to 1.6  $\mu$ . The diameter is about  $\cdot 25$   $\mu$ . The organism retains its spiral form when at rest. An undulatory membrane has not been demonstrated, and the existence of a nucleus is doubtful. The peripheral part is thinned out at each end to form a delicate flagellum. Fission takes place by longitudinal division, beginning with the formation of two flagellæ at one pole. The spirochæte is capable of backward or forward motion by corkscrew-like rotation round its longitudinal axis; in addition to this undulations course along its whole structure; lashing movements also occur. Mobility is retained for several hours in salt solution, but is lost in glycerine; the organism rapidly dies when deprived of moisture. *S. refringens* is a larger organism than *s. pallida*, and is distinctly refractile. It may have a marked corkscrew shape and motion when alive, but when dried in films flattens out so as to show a wavy outline. The curves are flatter and longer than those of *s. pallida*, measuring



from 1.5 to 2  $\mu$  or more. It varies in length, being most commonly from 8 to 10  $\mu$ . It possesses a vibratory membrane but no flagellæ.

*Detection of Spirochæte Pallida.*—The organism should be sought for in the deeper parts of lesions. The surface of a hard chancre should be thoroughly cleansed with soap and water, gently scraped, and then, from the fluid which exudes, smears made. The object of this is to avoid surface contamination with *s. refringens*. Another plan is to apply a vesicant to the skin and examine the serum; another, to puncture a bubo and remove some of the gland juice, as in searching for trypanosomes. Roseolar eruptions may also be scraped and punctured, or blood withdrawn from a vein (1 c.c. at least), diluted with ten volumes of .3 per cent. acetic acid, and centrifuged. The tissue juices from cases of hereditary syphilis may swarm with spirochætes. Spirochætes are visible in fresh preparations; they do not stain deeply; they are more difficult to recognise in sections than in film preparations.

For examining fresh preparations incandescent gas is better than day or electric light (Metchnikoff). The ultra-microscope (dark ground illumination) shows the organism readily. For staining films Giemsa's stain (Grübler & Co.) is generally employed; modifications of Pitfield's flagellar stain give good results. For sections von Ermenghem's method is used. Sections are placed for twenty-four to forty-eight hours in .2 to .5 per cent. nitrate of silver solution, rapidly washed in distilled water, and immersed for a quarter of an hour in gallic acid 5 grams, tannin 3 grams, sodium acetate 10 grams, distilled water 350 c.c., until they are tinged yellow. They are then replaced in the silver solution until they turn brown, and are washed and mounted as usual. In staining films with Giemsa, the air-dried film is fixed in absolute alcohol for from ten minutes to one hour, and immersed for twenty-four hours in diluted stain—15 drops to 10 c.c. distilled water. Spirochætes are stained pale violet; nuclei, deep red.

Shennan gives the following "axioms":—1. Saprophytic spirochætes are always present on ulcerated lesions, on moist papules, and on mucous plaques. 2. The more thorough the previous cleansing the fewer of these are seen. 3. Spirochæte pallida may be somewhat deeply in the lesion, and apparently in clumps; on account of this six or eight films must be made. 4. A little blood on the film is an advantage in focussing, and, moreover, spirochætes are often seen in apparent relationship to red blood corpuscles. 5. In the case of excised chancres and papules *s. pallida* is not demonstrable after from six to ten hours. 6. Films should be thin and fixed as soon as possible. 7. With Giemsa's method nuclei of leucocytes should be deep purple, almost black, otherwise the spirochætes will not be seen. 8. Decolourisers (alcohol or weak acetic acid) rapidly discharge the stain from *s. pallida*, except where the mordanting (flagella) methods are used.

*Biology.*—The exact position of the spirochæte is still uncertain. Schaudinn, whose researches were cut short by his untimely death, inclined to the view that it was a trypanosome, and certain analogies between trypanosomiasis and syphilis exist; the matter, however, is uncertain. Schaudinn rechristened the organism "spironema" and then "treponema" pallidum, but probably it will continue to be known generally as the spirochæte pallida until its exact relationship is ascertained.

In the body the spirochæte enters the vessels and lymphatics and is found in the blood stream. Its chief predilection is for the walls of



the lymphatics, whence it enters the intercellular and interfibrillary spaces of the tissues. It is found especially in connection with mononuclear infiltrations, and Metchnikoff believes that it exercises a chemotactic influence on these cells. It undergoes phagocytosis at their hands, and perhaps by the glandular and epithelial cells also. Nothing more is known as to its life history. It has not been cultivated outside the body.

It seems more than probable, almost certain, that *s. pallida* is the true cause of syphilis. Its almost constant presence in syphilitic, and its absence from non-syphilitic, lesions; its presence in experimental syphilis in apes; its abundance in the viscera in congenital syphilis—seem to exclude its being a saprophyte. The facts that the organisms disappear under efficient treatment; that, like the virus, they succumb to drying; that they are absent from fluids which are non-infectious (*e.g.* cerebro-spinal fluid), and present in those which are (saliva), point in the same direction.

**SERUM DIAGNOSIS OF SYPHILIS.**—The original Wassermann test is described under IMMUNITY DIAGNOSIS on pp. 237, 238. Since it was first introduced it has been the object of much research, and a number of modifications have been devised. Some of these are simpler than the original Wassermann, and may, in the near future, become available for ordinary clinical work.

It is now held by nearly all workers that the Wassermann reaction is not specific in the ordinary sense—*i.e.* the complement fixation is not dependent on the interaction of *bacterial* antibodies and antigens. What apparently happens is that in consequence of the action of the syphilitic virus tissue disintegration ensues, and lipoids are set free in the tissue juices. These lipoids play the part of antibody and antigen, the antibodies being possibly of the nature of cholesterin, the antigens being probably lecithin. However this may be, it has been shown that it is not necessary to use syphilitic foetal liver to prepare the antigen, but that extract of normal liver or heart, and sodium oleate, bile salts, or lecithin and other substances may be employed with success. Thus one of the difficulties in the original method—the need for an extract of syphilitic foetal liver—has been overcome.

Another modification facilitating the general use of the test is (a) either to take advantage of the normal property of human serum to lyse sheep's corpuscles, or (b) to employ the corpuscles of the patient, and to use a serum prepared by immunising a rabbit against human corpuscles. Of several tests based on these principles two may be referred to:—

1. *Fleming's Modification.*—Advantage is taken of the normal hæmolytic action of human serum on sheep's corpuscles: the serum to be tested is therefore made to supply complement and amboceptor. The materials required are alcoholic extract of heart, blood serum, and washed sheep's corpuscles. No more human serum is required than for the estimation of the opsonic index. Full details of the method will be found in the *Lancet*, 29th May 1909. An objection to this test, and others of the same type, is the variability, and occasional absence, of the hæmolytic-sheep-amboceptor in different specimens of human blood.

2. *Noguchi's Modification.*—In this use is made (1) of an anti-human amboceptor, prepared by injecting a rabbit with washed human corpuscles. There are also required (2) complement—fresh guinea-pig serum; (3) antigen—alcoholic extract of liver or 3 per cent. solution of



lecithin; (4) suspension of human corpuscles prepared by mixing one drop of normal blood to 4 c.c. saline solution; (5) serum to be tested, collected from ten drops of the patient's blood. Six tubes are used in performing the test. In one pair a drop of the patient's serum is placed, in the second pair a control normal serum, in the third pair a control syphilitic serum. Each tube then receives blood corpuscles, amboceptor, and complement, and one tube of each pair antigen. The test has been further simplified for clinical work by using pieces of filter papers saturated with the reagents and dried. These can be standardised; they keep indefinitely. Anti-human amboceptor slips, complement slips, and lecithin slips are supplied. They are dropped by means of forceps into three pairs of tubes containing suspension of corpuscles, suspected serum, and the two control serums. The tubes are incubated in the breast pocket.

*Porges Meier Reaction.*—Equal parts of blood serum and 1 per cent. emulsion of lecithin in normal saline are mixed and allowed to stand at room temperature for five hours. The lecithin emulsion is precipitated by syphilitic, not by normal serum. The results are said to be fairly comparable to those of the original Wassermann test.

SYPHILIS IN RELATION TO NERVOUS DISEASES, ESPECIALLY TABES AND GENERAL PARALYSIS.—The discovery of the cause of syphilis has, if anything, strengthened the widespread belief that tabes and general paralysis are syphilitic in origin. Mott and Spielmeyer have pointed out the very close resemblance which exists between the lesions of general paralysis and sleeping sickness. As has already been stated, Schaudinn regarded the spirochaete pallida as a species of trypanosome, and the conclusion is supported by the analogy of the disease of horses, *mal de coït* or *dourine*, the lesions and course of which resemble syphilis, and which is due to a trypanosome. In *mal de coït* and in syphilis the organism multiplies in the lymphatics; the same is true of sleeping sickness.

The syphilitic nature of tabes and general paralysis is further supported by the fact that in a large percentage of cases of these diseases a positive Wassermann reaction is obtained (see IMMUNITY DIAGNOSIS, p. 238).

Mott points to the following facts showing that syphilis is the essential cause of tabes and general paralysis:—1. The remarkable statistics of Erb. 2. Very few eminent neurologists or psychiatrists believe otherwise. 3. The cerebro-spinal fluid of tabes, general paralysis, and syphilitic meningitis invariably contains lymphocytes, often plasma cells, and no polynuclears. This occurs in no other *chronic* affection of the nervous system except sleeping sickness. 4. The existence of antisiphilitic bodies in the serum and cerebro-spinal fluid of tabes and general paralysis. 5. Krafft-Ebing's failure to inoculate general paralysis with syphilis. 6. In 80 per cent. of 40 cases of juvenile general paralysis syphilitic antecedents were determined, and in *no case* could the disease be excluded. 7. The Argyll-Robertson pupil is practically only met with in tabes, paralysis, and syphilis; it may be the only sign of syphilis. 8. In tabes the proportion of males to females affected depends on the social status—*i.e.* the liability to syphilis. In juvenile general paralysis, where the chances are equal, the sexes are equally affected.

Mott's view of the nature of parasymphilitic disease of the nervous system cannot be reproduced better than in his own words:—"Para-



syphilitic disease of the nervous system depends on two factors, intrinsic, innate, and extrinsic, acquired—the soil and the seed; the vital resistance and the specificity of the virus,  $\frac{V}{R}$ . All those conditions, which may be inherited or acquired, and which tend to active metabolism of systems, communities, and groups of neurons functionally correlated, and which, owing to these conditions of stress which in one individual would cause spinal neurasthenia, in another central neurasthenia, will, in conjunction with the stimulating effect of the syphilitic poison, cause the nerve cells to exercise an abnormal metabolic activity in the production of the side-chain molecules necessary for immunisation against the toxic effects of the virus.

“Ehrlich points out that we cannot suppose that the cells of the body possess *per se* an executive defensive capacity to neutralise the noxious effects of all forms of organisms, and his work on hæmolysins shows that the hæmolysin for the corpuscles of a particular animal only occurs after incorporation of the molecules of those corpuscles. But we may suppose that there is an *inherent* aptitude for the cells of the body of certain individuals to readily adapt themselves to defence against the action of the syphilitic virus in a race that has been widely syphilised for generations; consequently a larger number will have a mild form of the disease.

“The nerve cells are perpetual elements incapable of regeneration, highly differentiated and complex in structure and function, their centre of nutrition is the nucleus, and when decay sets in, the regressive process attacks first the fine twigs and branches of the tree, the dendrites and dendrons, and the rootlets; in fact, the process is an inversion of its growth and development. But what should cause this premature decay and lack of durability? for the specific energy of the whole of the neurons in the healthy body is sufficient to last until the vital spark dies out.

“We know that one attack of syphilis confers immunity during the rest of the individual's life, and the experiments of Krafft-Ebing are important to remember in this respect. The nerve elements being perpetual, having acquired a habit of throwing off side-chain molecules, will continue to do so during life and will contribute largely to the immunity produced. When there is no longer metabolic equilibrium, and decay sets in, these immune bodies are thrown off in increasing numbers; this seems probable from the fact that in general paralysis and tabes the quantities increase with the progress of the decay. The process of decay will manifest itself in the earliest stages by an increased irritability and functional activity of the nervous structures, often manifesting itself in a *hyperæsthesia sexualis*, and not infrequently in striking intellectual activity, followed in each case by exhaustion and loss of function.

“The uselessness of antisiphilitic remedies is thus easily accounted for; indeed they are generally positively injurious in true tabes and general paralysis, because they lower the vital energy in a system which has overimmunised itself against the syphilitic virus. The only hope of doing any good is by an early diagnosis of the disease and suppression of all those exciting causes which use up the nervous energy and tend to overturn the metabolic equilibrium of the central nervous system, causing its premature decay. This may explain a well-known fact, first pointed out by Benedikt, that tabetic patients who become



blind from optic atrophy remain in the preataxic stage a great number of years. Neuro-potential or nerve energy is for the most part used up in mental processes involving attention. The loss of sight necessitates mental inactivity provided the patient does not worry. My experience is that these cases of optic atrophy generally either remain in the preataxic stage or develop general paralysis. I have found in the history of the latter great mental depression arising from the loss of sight. Possibly some remedy may be found which will allay this hypernutritive and metabolic activity of the nervous system. It is, in my opinion, a fact that general paralytics and tabetics are very frequently mentally and physically superior to the average individual who belongs to the same social status, and I have always considered it probable that the frequent indulgence of abnormally strong sexual desires stimulated by many causes, especially alcohol, is, after syphilis, the most important factor in the production of tabes and general paralysis. It acts in two ways—(1) directly by exhaustion of neuro-potential; (2) indirectly in the male by the excessive loss to the body of highly phosphorised nucleo-proteids contained in the sperm. These are bio-chemical substances possessed of great specific energy, and are not easily replaced.”

#### TREATMENT OF SYPHILIS BY INTRAMUSCULAR INJECTIONS OF MERCURY.

—This method of giving mercury has been revived in recent years, especially in the army. Lieut.-Col. Lambkin states that the success which has attended it is out of all proportion to that which was obtained by the older methods.

Both soluble and insoluble preparations of mercury have been used. The disadvantage of the former is that, to be of any benefit, injections must be made daily, or at least three or four times a week; they are also painful, and the reaction is uncertain. The advantages of the insoluble preparations are that they are more active, reaction is more lasting, and that they need be injected less frequently—once a week or once a fortnight. Lambkin advises mercury cream, of the following composition:—

Hydrargyri . . . . .	℥ss.
Adipis lanæ anhyd. . . . .	℥ii.
Paraffin liquid (2 per cent. carbolic) ad . . . . .	℥v.
Maximum dose, ℞x. = gr. i. Hg once a week.	

*Technique of Treatment.*—Very thorough trituration of the mercury and lanoline is essential. Two hours should be spent on the process. The carbolised paraffin is then added, and the whole thoroughly stirred. It should again be thoroughly stirred before each injection. In hot climates it should be kept in an ice chest, as at a temperature above 90° F. the mercury tends to sink; in cold weather it should be warmed to about 90° F. so as to allow it to run through the needle.

Injections are made into the gluteal muscles with a platino-iridium needle attached to an all-glass syringe. The needle should be driven into the muscle with a single vertical thrust. Careful antiseptic precautions are required; the skin should be purified with 1 to 500 solution of perchloride, and the needle sterilised with boiling oil.

Lambkin's practice is to give a grain of metallic mercury every week until all symptoms have subsided—on an average, in 6 weeks to 2 months; then the injections are given once a fortnight for three months. A two months' rest is then allowed, then a second three



months' course of fortnightly injections. During the second year these three-month periods of treatment are alternated with two-month periods of rest, as may seem indicated. The average duration of treatment is two years. As adjuncts to treatment, hot air or Turkish baths should be taken, or daily hot baths, with plenty of exercise. The diet should be liberal; spirits are interdicted, and smoking discouraged. The gums require special care; the teeth should be brushed twice or thrice a day with an astringent mouth-wash (lead subacetate and alum). The body weight should be noted weekly, and the urine examined for albumin.

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**Tinea Capitis.**—Tinea capitis is notoriously difficult to cure, but since the introduction by Sabouraud and Noiré of Paris four years ago of a definite method for applying X-rays, the difficulty has been to a great extent removed. The aim of their method of treatment is to produce epilation by a single long exposure instead of by repeated short exposures at short intervals, as had been the method tried by other workers before. The head of the child is placed at 15 cm. (about 6 inches) from the antikathode of the X-ray tube, the current for which may be obtained either from an induction coil or a static machine. The tube is enclosed in a shield of metal or other composition impervious to the rays, and having an aperture from which projects a metal or lead-glass cylinder. The length of this projecting cylinder is such that when the X-ray tube is in position in the shield, the antikathode of the tube is exactly 15 cm. from the free end of the cylinder. The part of the child's head to be exposed is placed against the free end of the cylinder. The dose of X-rays given is not measured by the time of exposure, as the quantity and quality of rays being given out by the tube are constantly changing, but by the effect on a "pastille" consisting of small discs of cardboard coated with platino-cyanide of barium. This pastille changes colour from a greenish-yellow to a brown when exposed to the rays. The pastille is placed in a holder so as to be exposed to the rays, but at exactly half the distance, at which the child's head is, from the antikathode of the tube. The exposure is commenced, and from time to time the tint of the pastille is compared in good daylight with a standard tint known as Tint B. To reach this given tint usually takes 15-20 minutes. The quantity of rays necessary to change the pastille to the given shade is exactly sufficient to cause epilation of the exposed area. If this dose is not exceeded there is no danger of producing an X-ray dermatitis. On the other hand, if the dose is not sufficient to alter the colour of the pastille sufficiently within 25 minutes or so, the hair will probably not come out. If properly applied, the hair should become loose and fall out all over the exposed area in 18 to 21 days. It remains out



for 6 weeks to 2 months, and then grows in again, the regrowth being complete in from 3 to 4 months. Owing to the convexity of the scalp surface, only a comparatively small area can be exposed at a time. After the first area has been exposed it is marked with tincture of iodine or ink, and then covered with a disc of lead foil of the exact size, which is kept in position by a small elastic bandage. Another circular area, slightly overlapping the covered-up one, is then exposed till the tint on the pastille is obtained. This in turn is also covered with lead foil, and a third area exposed, and so on till all the area which it is desired to epilate has been exposed. There are various slight modifications of this method, which have been introduced by different workers, but the principle is always the same.

In all cases before the rays are applied it is advisable to have the hair cut quite short all over, so as to see how much disease is present. If there is only one diseased spot, the scalp should be rayed well beyond the diseased areas. It must be remembered that X-rays have absolutely no effect on the life of the ringworm fungus. Cultures of the fungus can be quite easily grown from the hairs which have fallen out after X-rays. If the area around a diseased area be not also rayed, before the hair has time to fall out the disease may have spread beyond the region exposed, and also diseased hairs, as they fall out after an X-ray exposure, are very apt to settle on a healthy part of the surrounding scalp, and so infect it. Therefore, if the disease is at all extensive, it is advisable to ray the whole head. In such cases the exposures cannot be given all in one day, as the child gets too restless, but on successive days.

The beneficial action of the X-rays is purely due to the mechanical removal of the diseased hairs and the temporary cessation of the hair growth. Whilst the hair is out, energetic local treatment should be carried on so as to kill any fungus which may be in the empty follicles, and which might reinfect the hair when it grows again. Should the hair not fall out after the first exposure, the treatment may be repeated 4-5 weeks later with safety. The only risk attached to this method of treatment is that an overdose be given and the hair does not grow again, but with proper care and attention to details the risk is very slight. Although Sabouraud cures his cases in about 6 weeks, such rapid cures have not been obtained in this country. It is found that diseased stumps remain in the follicles. Such stumps should be sought for and squeezed out if necessary by a comedo-extractor. These diseased stumps, however, must not be confused with atrophied stumps, which are like those seen in alopecia areata, and are not infrequently seen after X-ray treatment. When the hair grows in again after X-rays it is often somewhat curly and slightly darker in colour than previously.

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**Tuberculosis.**—The literature of tuberculosis has assumed such enormous dimensions as to render it impossible in the available space to summarise even any single branch of it. All that is attempted here is to give some general account of the work which has been done



in one or two directions—the relation of human and bovine tuberculosis, the question of the rôle played by alimentary infection, tuberculosis in infancy, and the treatment of the disease by tuberculin and other specific remedies. The diagnosis of tuberculosis by the various biological tests (oculo-reaction, etc.) is discussed in the section on IMMUNITY (pp. 239-244), where the opsonic index is also referred to. The more general aspects of the tuberculosis problem—the administrative control of phthisis, notification of the disease, sanatorium treatment, the control of the milk supply, the isolation of advanced and dangerously infectious cases of phthisis in rate-supported hospitals, municipal sanatoria, dispensaries, and colonies for convalescent cases—are, each and all of them, questions which must be omitted from further detailed mention. The list gives some idea of the manifold directions in which the disease is being attacked. The importance of the tuberculosis dispensary as a central point in the co-ordinated system of measures for dealing with the disease, so long and strenuously insisted on by Dr. R. W. Philip, is every year becoming more widely recognised—it acts as a receiving centre, an inquiry centre, a centre for disseminating information, and a distributing centre from which patients are drafted to hospitals; it serves as a link between the Public Health Department and the various philanthropic agencies which are concerned in tuberculosis. There is also a growing body of opinion in favour of compulsory notification of phthisis, though voices are not wanting to warn us that such notification may, in some cases, involve hardships no less than those it is intended to remove. It seems, however, that where the provisions of the law enforcing notification are applied sympathetically and with discretion, difficulties seldom arise. In connection with sanatorium treatment, the tendency at present is to depend largely on general hygienic conditions and fresh air, and the fashion of overfeeding patients is passing away. Zomotherapy, or a diet containing a considerable amount of raw meat, is the only special measure of the kind which has any considerable number of supporters. It is generally agreed that expensive and elaborate sanatoria are unnecessary; also that to make them fully effective a prolonged residence in them is essential, and that their sphere of usefulness can be greatly extended by the drafting of discharged patients to convalescent working colonies. In Germany the provision of sanatoria for the poorer classes is met to a considerable extent through insurance and state or municipal aid, and in this country some municipal sanatoria exist. For the most part, however, the curative work in connection with phthisis in Great Britain falls within the sphere of philanthropic agencies rather than that of the State; municipalities only admit their responsibility in so far as the isolation of infectious advanced cases in rate-supported hospitals is concerned. In no branch of medicine is there more widespread interest, and in none is the prospect so hopeful, as in the crusade against tuberculosis.

**HUMAN AND BOVINE TUBERCULOSIS.**—The relationship of human and bovine tuberculosis has been the object of much investigation since Koch's famous dictum in 1901. At the Tuberculosis Congress in London in that year he advanced the view that human tuberculosis cannot be transmitted to cattle, and that, if man be at all susceptible to bovine tuberculosis, the susceptibility is not pronounced—the infection of human beings is but a very rare occurrence. Kossell sums up Koch's teaching as follows:—"The tuberculosis of man and the pearl



disease of cattle owe their wide distribution not to the same germ. By injections of cultures of tubercle bacilli under the skin of cattle it is possible to determine whether one has to deal with a germ from a human or a bovine source. The tubercle bacillus derived from man cannot produce tuberculosis in cattle. Whether the bovine bacillus produces tuberculosis in a human being has not yet been definitely proved, but even if infection of humans by the bovine germ is possible, it is certainly of rare occurrence. To take measures against this remote possibility is therefore not advisable" (*nicht für geboten*).

The following three questions are then at issue, the third being subsidiary to the first and second:—(1) Is bovine tuberculosis spread by the same germ as human tuberculosis? (2) Are human and bovine tuberculosis reciprocally infectious? (3) If infection of human beings with bovine tuberculosis occurs, is this a frequent occurrence?

At the present time the evidence is that the bovine and human organisms are different; that human and bovine tuberculosis are reciprocally infective; and that, subject to certain qualifications, bovine tuberculous infection is fairly frequent in man. In amplification of these statements only the barest outline of the evidence can be given here.

SECOND INTERIM REPORT OF THE ROYAL COMMISSION ON TUBERCULOSIS (1907).—The commission is able to assert that animals and man can be reciprocally infected. Two types of bacillus, the bovine and the human, can be distinguished, but the difference between them is, in the main, one of virulence. The histological and anatomical features of the lesions caused by each are the same, except in degree. The bovine type of bacillus is much more virulent than the human type. The viruses obtained from cases of tuberculosis in man were found to be divisible into two types, one corresponding to the human type of bacillus, the other to the bovine type. This fact is of particular significance when the source of the two groups of viruses is considered. Of 14 cases yielding a virus corresponding in all respects to the bovine type, 10 were primary abdominal tuberculosis, 3 cervical glands, 1 phthisis. Of 40 cases yielding virus of the human type, 8 were primary abdominal tuberculosis, 10 respiratory tuberculosis, 9 bone and joint disease, 2 genito-urinary tuberculosis, and the rest cervical glands. Most of the cases, therefore, yielding a virus resembling that of bovine tuberculosis, were instances of alimentary infection; most of the other group were instances of infection arising outside the alimentary tract. The possibility of the two types of bacillus being, or becoming under suitable conditions, interchangeable, is still under investigation by the commission, and no definite statement can yet be made. The conclusions at which the commissioners arrive are:—(1) That a certain amount of tuberculosis, especially in children, is directly due to infection with the bovine bacillus. (2) That tuberculous milk is clearly a cause of tuberculosis, and fatal tuberculosis, in man. (3) That a very large proportion of tuberculosis contracted by ingestion is due to bovine bacilli. (4) That more stringent measures are required to prevent the sale or consumption of milk from tuberculous cows.

At about the same time as the appointment of the English commission, a German commission set to work on the same lines. According to the first report (*Tuberkulose-Arbeiten aus dem Kaiserlichen Gesundheitsamte*, Heft I. (Berlin) 1904) the scheme of work planned was as follows:—Separation of fresh strains of bacilli from human



tuberculosis, and inoculation of calves. Inhalation experiments on calves and sucking pigs with the more virulent cultures. Testing the effect of passing weakly virulent strains through goats. Similar observations with bovine tuberculosis. It was shown that subcutaneous inoculation of calves with bovine bacilli caused fatal generalised tuberculosis. Forty-one strains of human bacilli were injected into 57 calves; no fatal case of tuberculosis followed. The calves inoculated with human bacilli fell into three groups. I. Shoulder glands showing no permanent change, or only traces of healed tubercle; no extension of the infection. II. Localisation less distinct; other adjacent glands affected. III. General disseminated tuberculosis was produced by four strains of bacilli. Of these four strains, one was from the lungs, three from mesenteric glands; all were derived from children. Of ten cases of primary alimentary infection, three appeared to be due to the bovine virus.

The subject was reviewed by Kossell, one of the members of the German commission, at the Tuberculosis Conference of 1905, who came to the following conclusions:—

1. By bacteriological investigation of tuberculous lesions in human beings, cattle, and swine, two types of tubercle bacilli can be detected which may provisionally be called *typus humanus* and *typus bovinus*.

2. The widely-spread tuberculosis of cattle is to be traced exclusively to infection with tubercle bacilli of the *typus bovinus*.

3. Swine are susceptible in a high degree to the tubercle bacilli of the *typus bovinus*, in a lesser degree to those of the *typus humanus*.

4. The tuberculosis of human beings chiefly arises from infection with tubercle bacilli of the *typus humanus*, which is transmissible from man to man.

5. Tuberculous lesions in human beings can be produced by tubercle bacilli of the *typus bovinus*.

6. Tubercle bacilli of the *typus bovinus* can be transmitted to human beings by food derived from tuberculous animals, especially by milk of cows affected with tuberculosis of the udder.

7. The part played by infection from bovine sources in spreading tuberculosis in man is small in comparison to the danger threatening from a consumptive human being.

The following resolution was adopted by the Congress:—“The congress, after hearing the *exposé* of the most recent investigations, declares that it is not only indispensable to avoid contagion from man to man, but also to pursue the prophylaxis of bovine tuberculosis, and to continue to take administrative and hygienic measures to avert its possible transmission to our species; and finally, that it is desirable to be on our guard against all forms of animal tuberculosis.” In the discussion on bovine and human tuberculosis at the Washington Congress of 1908 the problem was not seriously influenced. We must put aside for the time being, as still *sub judice*, such questions as the exact meaning of the cultural and other differences between the bovine and human bacilli—are these different species? are they merely different types? or is there but one tubercle bacillus which may acquire modifications under suitable circumstances, or in appropriate environment, and lose them again when conditions change? Before these questions can be answered a great deal of painstaking and minute research will be required.

It is practically more important at present to try and give some



answer to the third question raised at the outset, viz., Is infection of man with the bovine bacillus a frequent occurrence? Koch's position is, that desirable as it may be to eradicate bovine tuberculosis, the prevention of human tuberculosis depends essentially on checking its transmission from man to man through the agency of bacilliferous sputum. He objects to this central preventive measure being complicated by insistence on precautions directed towards securing a pure milk supply, and to the stamping out of bovine tuberculosis.

As regards phthisis, there is very little direct evidence that it is ever due to infection with the bovine virus. The cases in which bovine bacilli have been isolated from the cavities in lungs are few, and not free from doubt. On the other hand there is good reason to think that primary abdominal tuberculosis is not uncommonly of bovine origin. The findings of the Royal Commission on this question have already been mentioned. Weber, one of the German commission, in a later report, states that of 84 cases of tuberculosis in children which were exhaustively studied, no less than 21 were infected by the bovine bacillus; 6 of these were tuberculosis of the cervical glands, while 13 were cases of primary abdominal tuberculosis. In the whole series of 84 patients there were 21 cases of primary abdominal tuberculosis, of which 7 gave the human bacillus. Weber's results, therefore, are quite comparable to those of the Royal Commission, and they are rendered if anything more weighty by the fact that abdominal tuberculosis is less common in Germany than in England (*vide infra*).

Raw holds an extreme, and in some respects isolated position on this subject. According to his theory, bovine and human tuberculosis are essentially different infections. He points out (1) that in pulmonary tuberculosis the disease is nearly always strictly confined to the lungs, with, in a fair percentage of cases, secondary ulcers of the intestine, but seldom any other tuberculous lesion. Phthisis is essentially a disease of adult life. (2) Tuberculous joints, enlarged glands, spinal disease, and abdominal tuberculosis are essentially affections of infancy and childhood; moreover, it is rare for such patients to develop true phthisis pulmonalis. Raw believes that true primary pulmonary tuberculosis arises from the inhalation of tuberculous matter; other forms are probably caused by ingestion of bacilli. His main contentions are:—(1) Tubercle bacilli of the human type produce pulmonary tuberculosis, tubercular ulcers of the bowel, and tuberculous abdominal glands. (2) Bovine bacilli produce mesenteric tuberculosis, tuberculous peritonitis, acute miliary tuberculosis, tubercle of bones and joints, tuberculous meningitis, and probably lupus. (3) The two forms are antagonistic, and a mild attack of bovine tuberculosis protects against pulmonary phthisis. (4) Human tuberculin has a curative effect on bovine tuberculous infection; bovine tuberculin has a curative effect on the pulmonary form of the disease. Raw's theory is based on clinical observation; he regards the nature of the infection—alimentary or inhalation—as practically synonymous with its source—bovine or human. One difficulty in the way of accepting Raw's theory as it stands is the lack of evidence that bone and meningeal tuberculosis are due to ingestion of bacilli. Weber, whose results have been quoted, examined 27 cases of tuberculosis of bones and joints, and 48 cases of tuberculous meningitis and phthisis, and found that only one of the former, and none of the latter, were due to the bovine bacillus.

Behring's theory of tuberculous infection, though it has no direct



bearing on the relative frequency of bovine and human tuberculosis, must also be referred to, because if carried to its logical conclusion it stands directly opposed to Koch's views. Behring believes that tuberculosis is invariably acquired in infancy. Phthisis in the adult is simply the last episode in a life-long infection—"the concluding verse of the infant's cradle song." This is really the essence of Behring's theory. The infant becomes tuberculous by ingesting bacilli; these may be bovine, as when the milk of infected cattle is used; they may also be derived from human beings, from dust, dried sputum, infected rooms, etc., but in any case they gain entry to the mouth in the first instance, and are swallowed along with the food. The need for accepting the latter possibility as well as the former is shown by the occurrence of tuberculosis in infants reared on the breast or on sterilised milk. The deduction Behring draws is that all efforts to eradicate tuberculosis must be primarily directed towards shielding children from infection, both by securing tubercle-free milk, and by keeping them away from infected adults and houses. Direct infection of adults he regards as relatively infrequent, and looks on the exaltation of systematic disinfection of sputum as tending to divert the attention of the public from the real source of danger.

Behring's theory is not very widely held. It is referred to here chiefly because it brings into prominence one aspect of the tuberculosis problem which has attracted renewed attention of late years, viz., the frequency and importance of tuberculous infection in infants and children. Without depreciating the importance of systematic disinfection of the sputum, it must be stated that in view of the enormous susceptibility of infants to tuberculosis they have very special claims to consideration in the campaign against tuberculosis. Holt goes so far as to say that when an infant or young child suffers from chronic cough and is known to have been exposed to a "house infection" it must be regarded as presumably tuberculous. He regards pulmonary tuberculosis as common in infants, and as probably due to infection from a case of phthisis (45 per cent. of cases in his own observation).

As has been said, there is little or no bacteriological evidence that ordinary pulmonary phthisis is ever due to the bovine bacillus, and there is a fair amount of evidence that primary abdominal tuberculosis is often due to the bovine bacillus. While bacteriological investigation is the only way of proving definitely to which virus a case is due, the fact that bovine bacilli are most likely to give rise to an alimentary infection, leads up to the question of the relative frequency of primary abdominal tuberculosis.

**ALIMENTARY INFECTION.**—At the 1908 Congress there was a general consensus of opinion that tuberculosis could be acquired either by ingestion or inhalation. In his article on TUBERCULOSIS in the *Encyclopædia Medica*, Dr. Shennan gives 27 per cent. as the proportion of cases of alimentary infection in post-mortems on children in Edinburgh up to 1901; at the Congress he reported on statistics up to date; the later figures substantiated the earlier ones. Harbitz of Christiania found that in 177 autopsies in children under 15 years there was a primary abdominal infection in 22 per cent. Calmette's work points to the alimentary canal as being a very important point of entry of the bacillus. His conclusions run as follows (Raw):—

1. Animals readily contract tuberculosis by way of the intestine, not only in youth, but also during adult life, without the passage of the



bacilli through the walls of the digestive tube being marked by any visible lesions.

2. In the case of young animals bacilli are ordinarily retained by the mesenteric glands. Sometimes the infection remains localised there for a longer or shorter period, and is in the end cured; sometimes it ends in the formation of caseous tubercles, and is then propagated by the efferent lymphatics to the major lymphatic circulation.

3. In the case of adult animals whose defensive glandular reaction is much less active, the bacilli are more generally carried, with the leucocytes containing them, into the major lymphatic circulation and by way of the pulmonary artery towards the lung.

4. The so-called primary pulmonary tuberculosis is generally intestinal in origin.

5. Finally, of all methods of infection, that by way of the digestive canal is at once the most efficacious, and that which best agrees with the normal conditions of natural infection.

Despite the contrary opinions held by a few authorities (*e.g.* Holt and Coutts) there is at present a tendency to admit that alimentary infection plays an important part in causing the disease, and one cannot escape from the idea that this tendency is associated with the great interest which has recently been taken in tuberculosis in children. Only in late years has the great frequency of tuberculosis in infancy and childhood been properly realised. It is unnecessary to labour this point, but the following statistics, compiled by Dunn, may be quoted. They are based on post-mortem examinations.

Age.	Percentage of Cases of Tuberculosis.
0- 3 months . . . . .	0 %- 2 %
4- 6 „ . . . . .	16 %-17 %
7-12 „ . . . . .	22 %-26 %
1- 2 years . . . . .	42 %-44 %
2-10 „ . . . . .	67 %
10-15 „ . . . . .	64 %-77 %

Infantile tuberculosis is essentially a disease of the lymphatic organs; the bacilli do not, as a rule, cause a demonstrable primary lesion of the skin or mucous membrane, but localise themselves in a gland and set up a chronic process there. The spread is by lymphatics; sometimes there is a general miliary tuberculosis. The younger the child, the less the tendency to cure; if a definite tuberculous lesion is clinically demonstrated during the first year the prospect of recovery is small. Behring's theory has most of its supporters among those who have studied diseases of children—Schlossmann, for instance, thinks it is the most important advance made since Koch's discovery of the bacillus.

An interesting point in connection with tuberculosis in childhood is the relative frequency of abdominal tuberculosis in different countries. The disease is apparently much less common in America and Germany than in Great Britain; it is particularly common in Edinburgh and Glasgow. Drs. Thomson and Fordyce have collected statistics from a great number of hospitals bearing on this point. In Edinburgh and Glasgow the proportion of clinical abdominal tuberculosis among in-patients is 3·6 per cent. and 4·6 per cent. respectively, as against 1·8 per cent. in London (Great Ormond Street). In the United States it is



under .5 per cent., and in all the Continental hospitals which furnished statistics, except Buda-Pesth (2 per cent.), it is under 1 per cent. In Great Britain abdominal tuberculosis is more common among hospital in-patients than tuberculous meningitis; in Germany and America the reverse is the case.

It is impossible to say on what these variations depend. The obvious suggestion that they may be related to infection with tuberculous milk is fraught with difficulties. It is plausible enough to suppose that in Great Britain sterilisation of milk is less carefully attended to than in Germany, France, and America, but a great deal of comparative inquiry into the details of artificial feeding as practised in these countries is required before this point can be settled. Coutts points out that were milk a frequent source of infection abdominal tuberculosis would be extremely common, instead of rare, during the first year of life. He states that it has never been proved that the complaint is more common in hand-fed children than in those which are suckled, further than the more frequent occurrence of chronic intestinal disorders in the former would account for. In Rome the death-rate among children under 15 from tuberculous meningitis (1896-1905) was 4.7 per cent.; from tuberculous peritonitis, 3.0 per cent.; yet in Italy, among the poorer classes, artificial feeding of infants is almost never resorted to. In Japan, where cow's milk is not used, tuberculosis is said to be extremely common. One strong argument in favour of milk-borne infection being associated with these variations in the frequency of abdominal tuberculosis is furnished by the United States. There, the necessity of a clean milk has been more strongly urged than in any other country, and there abdominal tuberculosis is least frequent. Moreover, it is the experience of so eminent an authority as Emmet Holt that tubercle is rarely conveyed by milk.

While, therefore, the relative frequency of human and bovine tuberculosis, of infection by ingestion and inhalation, is still unsettled, there is no doubt whatever of the great susceptibility of infants to the disease, and it follows that the protection of babies and children from all possible sources of infection must form an important part of the crusade against tuberculosis.

**TUBERCULIN TREATMENT.**—A number of different preparations pass under the generic name tuberculin. The most important of these are Koch's Old (1890) Tuberculin, Koch's New (1897) Tuberculin—known as O.T. and T.R. (R=residue) respectively; Tuberculocidin—Kleb's Tuberculin; Deny's Tuberculin—*Bouillon Filtre* (B.F.); Koch's *Bacillen-emulsion* (B.E.); and Béraneck's Tuberculin. Marmoreck's serum and Maragliano's serum are antituberculous serums. At the Tuberculosis Congress of 1905 Professor v. Behring announced a new remedy derived from the virus of tuberculosis, which he named T.C. This was stated to consist of tubercle bacilli freed from (a) toxic materials soluble in water, (b) toxic globulins soluble in salt solution, and (c) non-toxic principles soluble in alcohol, etc. The residue—*rest-bacillus*—can be so modified as to be directly capable of absorption by the lymphatic cells of an animal, during which process a state of immunity evolves. A fundamental fact in connection with T.C. is that it has the power of producing tuberculous nodules, which, however, do not caseate. Since Behring's original and very vague communication, practically nothing further has been heard of the matter.

Old tuberculin is a glycerine extract of tubercle bacilli from which



the dead bacilli are filtered off. New tuberculin is prepared by treating the pounded bodies of dried bacilli with saline solution, and centrifuging the mixture. The deposit (T.R.) is made up with water. A mixture of T.R. and the opalescent fluid separated from it by the centrifuge is called Bacillen Emulsion (B.E.). Deny's tuberculin is a filtered Bouillon culture of bacilli. Béraneck's tuberculin is an extract. In all probability these tuberculins do not differ fundamentally from one another.

Of these remedies Koch's new tuberculin is that which is by far the most widely used in this country at the present time. It is manufactured by Meister, Lucius & Bruning, who supply it in small phials containing 10 mgr. of solid substance.<sup>1</sup> Before use it must be diluted with 20 per cent. glycerine in distilled water, and as great care is necessary both to secure sterility and exactitude in dosage, it is best to procure it from some firm of wholesale chemists which sends out single doses sealed in glass capsules ready for use.

A great impetus to the use of tuberculin in this country was given by Wright's researches on the opsonic index and on vaccine therapy (*vide* IMMUNITY, pp. 239, 241). Wright found that while the tuberculo-opsonic index in healthy persons was between .8 and 1.2, in tuberculous patients with localised lesions the index was persistently low, while if the disease was widespread or active the index fluctuated greatly, the rises and falls being due to periodic auto-inoculation. When the index is raised in localised tuberculous lesions there is a tendency towards healing, and by the injection of small doses of tuberculin a rise in the opsonic index is brought about. The immediate result of inoculating a tuberculous patient with tuberculin is to lower the index (negative phase); the fall is succeeded by a rise ("positive phase"), and thus in a variable time the index returns more or less to its old level. The negative phase varies according as a larger or smaller dose of vaccine is inoculated. In the former case the negative phase may disclose itself by temperature reaction; in the latter case it may be unassociated with clinical symptoms. The positive phase is characterised by an increased antibacterial power of the blood, and may be accompanied by a very pronounced feeling of well-being. If serial injections be made during successive negative phases of reduced antibacterial power a cumulative effect in the direction of the negative phase occurs. It is not, however, possible in connection with anti-tuberculous inoculations to bring about a cumulative effect in the direction of the positive phase by serial injections during positive phases (Wright). The object aimed at is to maintain the opsonic index at as high a level as possible for as long a period as possible, and therefore an accumulation of negative phases, or a too prolonged negative phase from a large dose of tuberculin must be avoided. Wright advises that each inoculation should be looked upon as a separate operation, and that no attempt should be made to lengthen the positive phase by reinoculation during the positive phase. In every case the smallest dose should be given which will elicit a satisfactory response. The dose should be repeated only when the effect of the preceding inoculation is passing off. The dose should be increased only when it is clear that the dose

<sup>1</sup> It seems that each phial actually contains only 2 mgrs. of solid substance = 10 mgr. tubercle bacilli. Thus the doses given required to be renamed ;  $\frac{1}{1000}$  mgr. = only  $\frac{1}{5000}$  mgr. solid substance. In the text, however, the old nomenclature has been followed,  $\frac{1}{1000}$  mgr. =  $\frac{1}{10000}$  of a phial of T.R.



previously employed is ceasing to evoke a sufficient immunising response. As a rule inoculations are made about every tenth or fourteenth day. Wright begins with a dose of not more than  $\frac{1}{1000}$  mgr. T.R. and never advances to doses of more than  $\frac{1}{500}$  mgr.

While it is probably the case that the administration of tuberculin can be better controlled by estimations of the opsonic index than by any other method, it is apparent that if such estimations are held to be essential to the safe use of the remedy, many patients must be deprived of its benefits, on account of the laborious nature of opsonic methods. Moreover, the soundness of the opsonic theory is not unquestioned, and a clear distinction must be made between the value of the opsonic index on the one hand, and the value of vaccine therapy on the other. Whether the opsonic theory stands or falls, the value of antituberculous vaccination must and will be settled on its own merits. Many, probably most, physicians who employ tuberculin are guided as to dosage by the general principles deduced by Wright, and by the clinical observation of each case. It is probably inadvisable to employ tuberculin except in apyrexial tuberculosis. The patient should remain in bed under observation for some days before treatment begins, and for some time thereafter until it is certain that he is not reacting unfavourably. The initial dose should be small— $\frac{1}{2000}$ – $\frac{1}{1000}$  mgr. T.R. for adults;  $\frac{1}{7500}$ – $\frac{1}{5000}$  mgr. for children. Its effects, particularly on the temperature, should be carefully watched, and it is not repeated, or repeated only in diminished dose, if reaction of any kind follows. Reinoculations are made at intervals of ten to fourteen days. This method of administration—the clinical method—is that generally adopted in America and Germany. There, however, larger doses ( $\frac{1}{500}$  mgr.) are used to begin, and are increased up to several milligrams.

Treatment by tuberculin must be continued for several months to yield good results. Tuberculin is contra-indicated by persistent pyrexia above  $99.5^{\circ}$ , by persistent rapidity of the pulse (over 100), by rapid wasting, by miliary tuberculosis or tuberculous meningitis, and by hæmoptysis. Nephritis and epilepsy are further contra-indications.

In the preceding remarks reference has been made only to T.R., because this is the favourite preparation in this country, and is probably used many times as often as all the other tuberculins put together. The principles underlying the use of tuberculin are, however, the same whichever be chosen. Sahli, in a recent review, expresses the opinion that, however obtained—O.T., T.R., Béraneck's tuberculin, B.F., etc.—tuberculin is essentially the same; the skill of the physician using it is more important than the brand employed.

The following are the doses of some of the other tuberculins:—

*Koch's Old Tuberculin*,  $\frac{1}{100}$ – $\frac{1}{10}$  mgr. increasing to 1000 mgr. Reactions are said to occur chiefly after the earlier, small, doses; if this period be passed over there is less likelihood of reactions occurring. The intervals between the early inoculations are short—only a few days; between the later, large, doses, several weeks. Dosage increases rapidly—e.g.  $\frac{1}{100}$  mgr.,  $\frac{1}{10}$  mgr., 1 mgr., 5 mgr., 10 mgr., 25 mgr., etc.

*Bacillen Emulsion*,  $\frac{1}{20000}$ – $\frac{1}{10000}$  mgr., increasing to a maximum of 5 mgr.

*Deny's Tuberculin*,  $\frac{1}{10000}$  mgr. rising gradually to 1 mgr.

*Béraneck's Tuberculin* is praised by R. W. Philip and Sahli. The former begins with a dose of .1 c.c. of a 1:100,000 solution. Injections are made at intervals of three to fourteen days, the effects being gauged



by careful records of the temperature, pulse, general condition of the patient, and local manifestations. Regular estimation of the opsonic index is unnecessary. It is desirable to repeat the same dose more than once, so as to make sure that no reaction has been missed. If an external surgical lesion is being treated, the direct injection of a stronger solution (.1 c.c. of 1:100) may be made. This is not repeated until all local reaction (if any) has subsided; if there is no reaction the dose may be increased by tenths of a cubic centimetre. T.R. has been used as a 5 per cent. ointment in the local treatment of lupus.

In cases of tuberculosis, which fail to respond to T.R., and in which there is the possibility of infection with the bovine virus—*e.g.* in abdominal tuberculosis—*Perlsucht* tuberculin (P.T.R.) may be tried (cf. Raw's opinion, *antea*, p. 447). When there is a mixed injection, as in pulmonary phthisis, it is advisable to combine tuberculin with the appropriate vaccine treatment. Recently tuberculin has been used by oral and rectal administration, and good results have been reported by some.

*Antituberculous Serums.*—Attempts to produce efficient antisera have failed. Maragliano's serum and Marmoreck's serum are the best-known members of this class.

It is not possible to estimate the real benefit of tuberculin treatment by statistics. Most physicians and surgeons who have employed it have convinced themselves that it does good in properly-selected cases. The fact that it has now overcome the prejudice which its use excited in the early nineties is perhaps the best proof that it is really a valuable remedy.

**LITERATURE.**—The literature of opsonins and antituberculous inoculation is very large, and numerous papers will be found in the journals from 1903 onwards. The following papers may be referred to:—A. E. WRIGHT. *Lancet*, 2nd Dec. 1905.—TRUDEAU. *Amer. Journ. Med. Sci.*, Aug. 1906.—LATHAM (T.R. by mouth). *Proc. Roy. Soc. Med.*, i. p. 195, 1908.—RIVIERE (children). *Tuberculosis in Infancy and Childhood*, ed. Kelynack (Lond.), 1908.—BULLOCH. *Lancet*, 2nd Dec. 1905.—SAHLI. *Corr.-bl. f. Schweiz. Aerzte*, 15th June, 1st July, 1906.—R. W. PHILIP. *Edin. Med. Journ.*, Feb. 1909.

**Tuberose Sclerosis.**—Until comparatively recent years our knowledge of mental defect has remained very much at the level of what our knowledge of organic nervous disease was fifty years ago, when "paralysis" was considered a complete and sufficient diagnosis. The studies of neurologists showed that paralysis was merely a symptom, and that the cases grouped under the general head were really examples of a great variety of clinical and pathological conditions. In the same way we are now learning to recognise among idiots and imbeciles many different types, some of them, such as mongolism, distinguished mainly by their clinical features, others, such as syphilitic dementia, by their cause and course, others, such as amaurotic idiocy, by their well-defined symptoms and a characteristic anatomical lesion. There is every reason, however, to believe that the great group of idiots, imbeciles, and mental defectives is capable of still further classification on a clinico-pathological basis—in a word, that when they are submitted to the same searching investigation as other cases of nervous disease have been, we shall find that we have been comprehending under a generic name diseases which are essentially different from one another. It may, of course, be argued that since mental defect is incurable little good can be expected to ensue: the answer to this is found in the statement



that only when we can recognise the varieties which undoubtedly exist shall we be able to give a definite prognosis as to the mental future, and as to the duration of life, or to give the best advice as to the line of treatment, institutional or otherwise, required.

The most recently isolated type of mental defect is that which has as its pathological basis a lesion of the brain first described by Bourneville in 1880 as tuberoze sclerosis. In the twenty or twenty-four years following his paper only ten or a dozen further cases were recorded, and the condition was looked on merely as a rather rare pathological curiosity. During the last few years, however, since the inmates of imbecile institutions have received more attention from physicians and pathologists, it has been found that tuberoze sclerosis is less rare than was supposed, and that the patients have sufficiently well marked symptoms during life to render a correct diagnosis possible in a number of cases.

In the light of the work of recent observers, among whom the names of Vogt and Pellizzi must especially be mentioned, tuberoze sclerosis may be characterised as a tumour-like lesion of the cerebral cortex, with the simultaneous occurrence of tumours of the kidney, and of the skin, and sometimes of the heart and other viscera. It is a congenital disease and is associated with a greater or less degree of progressive mental deterioration, almost invariably with epilepsy, and often with adenoma sebaceum. It is usually fatal at a comparatively early age.

Tuberoze sclerosis has attracted more attention from the pathologist than the clinician, and the lesions have been the subject of a number of papers. The naked-eye appearance of the brain is so characteristic as to render the recognition of the condition easy. Scattered here and there over the surface of the cerebrum single convolutions, or adjacent parts of convolutions, stand up, broader than usual, above the rest of the surface of the brain-like little tumours. They are hard to the touch, and look and feel like hypertrophied brain tissue. The pia is normal and strips readily; there is no evidence of inflammatory change, and the general configuration of the brain is in no wise altered, save for the nodular appearance of many of the convolutions. On section the nodular areas are greyish-white in colour and merge insensibly into the white matter of the brain, the distinction between cortex and medulla being obliterated. In addition to this lesion, small tumour-like outgrowths are generally found on the walls of the lateral ventricles, chiefly in the thalamic region. In rare cases the cerebellum is also the seat of tuberoze sclerosis, and sometimes little tumours occur in the fourth as well as the lateral ventricles. A very remarkable feature of the disease is the fact that in about half of the cases recorded tumours have been found in the kidneys, and as in many reports the kidneys were not examined it is probable that the association is actually more frequent. The renal tumours are usually described as of the nature of hypernephromata, and in one or two instances were the immediate cause of death. Among other internal organs liable to be involved by tumour growth, the heart comes next in frequency. Small whitish tumours of embryonic muscular tissue (rhabdomyomata) are described in its wall in several cases. In one case an adenomatous tumour of the thyroid was present. Without considering the histological appearances in detail, it may be said that the changes in the nervous system consist of maldevelopment and degeneration of the pyramidal cells of the cortex, and overgrowth of glial tissue. Sailer



describes it as a nodular gliosis. The visceral tumours are variously described as sarcomata, liposarcomata, adenomata, etc.

The connecting link between these various lesions is that all are of a developmental nature. The disease is unquestionably congenital, because it may occur in a well-marked degree in infants only a month or two old; in these early cases there is distinct evidence of maldevelopment of the nerve cells, as well as retrogressive changes and gliosis. The developmental origin of renal tumour in childhood is also generally admitted. Adenoma sebaceum is also regarded by Crocker as a maldevelopment of the glandular structures of the skin. Two types of adenoma sebaceum are recognised: one affecting chiefly the face, and consisting of small nodules symmetrically distributed, chiefly on the cheeks; the other, affecting the skin of the head and back as well as the face, in which the nodules are much larger, and are asymmetrically distributed. Adenoma sebaceum has been recognised by dermatologists as being most frequent in mentally defective children; it is common among the inmates of institutions for the care of imbeciles.

**CLINICAL FEATURES.**—Like so many other imbeciles, children with tuberosc sclerosis often have a bad heredity. The degree of mental defect is usually considerable; some cases are merely vegetative idiots; others have intelligence enough to benefit from ordinary elementary education. What is more characteristic than the grade of mental defect is the fact that it is progressive. In many cases the intelligence appears to have developed fairly normally for the first year or so, until the first convulsions occurred. With the onset of epilepsy deterioration sets in, and with the progress of the disease the patient may sink into dementia. The epilepsy is not specially characteristic. At first the convulsions tend to remain limited to the head and eyes, but ultimately they become general. Minor epilepsy usually accompanies the major seizures. The fits tend to occur in small series of three or four at a time at intervals of a week or a fortnight. Many patients succumb in a *status epilepticus*. Some patients ultimately develop spastic paralysis and become bedridden. In a few cases epilepsy does not supervene; there is merely mental defect.

**DIAGNOSIS.**—The possibility of tuberosc sclerosis has to be considered in all cases of epileptic imbecility, and search should be made for any sign of tumour of the kidneys or other viscera. Adenoma sebaceum is highly suggestive of the existence of tuberosc sclerosis, if not, indeed, pathognomonic. Few of the patients survive to adult life; many die about puberty. Death may result directly from the renal tumours, or from epilepsy. Most cases in which there is a lesion of the heart appear to die in infancy, sometimes before convulsions or symptoms of mental defect have occurred.

**LITERATURE.**—References to the older literature will be found in most of the following recent papers:—VOGT. *Münch. med. Wochensch.*, 29th Sept. 1908; *Zeitsch. f. d. Erforschung u. Behandlung des jugendlichen Schwachsinnns*, Bd. ii. Heft 1, 1908; *Monatssch. f. Psychiatrie u. Neurologie*, Bd. xxiv. p. 106, 1908.—JACOBÆUS. *Nord. med. Archiv.*, Abt. ii. Nr. 2, 1903.—SAILER. *Journ. Mental and Nervous Diseases*, p. 402, 1898.—MARKUSE. *Neurol. Zentralb.*, 2, p. 104, 1909.—VOLLAND. *Zeitsch. f. d. Erforschung u. Behandlung d. jugendlichen Schwachsinnns*, Bd. iii. Heft 3, 1909.

**Typhoid Fever.**—The conception of typhoid fever in vogue a few years ago, namely, that of a disease due to an intestinal infection by a specific organism, which proliferates in the bowel, whence it invades



the body through the intestinal wall, causing a general infection, has undergone considerable modification recently. In the first place, typhoid fever must now be regarded as a primary bacterial infection of the blood with secondary involvement of the intestine, and, in the second place, it has to be admitted that the clinical group of symptoms known collectively as typhoid is not always due to the Eberth bacillus.

1. TYPHOID A BACILLÆMIA.—The bacillus of typhoid is constantly present in the blood from the onset of an attack of typhoid fever. Coleman and Buxton<sup>1</sup> found that out of a total of 1602 cases examined 75 per cent. showed bacilli in the blood. A positive result is most constantly obtained towards the beginning of the disease—during the first week in 89 per cent.; during the second, 73 per cent.; during the third, 60 per cent.; during the fourth, only 38 per cent., of those examined. So many observers have found the organism in approximately 100 per cent. of their cases, that probably the failure of the minority to detect them is due to faulty technique. Bacilli can always be found in the blood before a positive Widal test is obtained; in some cases they have been cultivated from it during the incubation period. They disappear from the blood as the temperature falls. The bacilli are excreted by the liver into the bile, by which they pass over into the gall bladder and bowel; in both these structures they set up local lesions—cholecystitis and ulcers. In the bowel some die, some are expelled in the stools; probably they do not multiply. They are not found in the fæces during the early stage of the disease, and can be regularly demonstrated only when ulceration is established. On post-mortem examination they are most abundant in the duodenum, and diminish in number as we pass down the intestine; they are not found in the rectum. Relapses are due to reinvasion of the blood stream. On these facts, the pathology of the disease may be briefly stated as follows:—Typhoid bacilli enter the blood stream directly (possibly by the pharynx or stomach), and multiply there during the incubation period. At this time their presence can sometimes be demonstrated directly, or, before they themselves can be isolated, their products can be detected by the precipitin test (Fornet). At or before the onset of the symptoms, they enter the gall bladder and bowel, ultimately set up cholecystitis and ulceration of the Peyer's patches, and are excreted in the fæces. The symptoms of the disease are caused by the destruction of enormous numbers of bacilli in the blood and liberation of their endotoxins. When the bacilli invade the body locally (*e.g.* in typhoid abscess or meningitis) the liberation of the endotoxins does not cause the general symptoms of typhoid fever.

*Blood Cultures in Typhoid.*—Kayser's ox-bile medium is used. Peabody<sup>2</sup> procures 1-2 c.cm. blood from a puncture of the lobe of the ear, and adds it to 5 c.c. sterile ox-bile, then incubating for 15 hours. Microscopic examination of a drop may show the organisms, otherwise a tube of coagulated serum is inoculated with the bile and incubated for several hours, when the motile bacilli can be found in the water of condensation.

2. CLINICAL SYNDROME "TYPHOID FEVER" DUE TO MORE THAN ONE ORGANISM.—The existence of so-called "paratyphoid" has now been recognised for a number of years, and the position now taken up by many authorities is that (*a*) a disease clinically indistinguishable from typhoid fever may be caused by several varieties of organism, and (*b*) both the Eberth's bacillus, and the other organisms to be referred to, may cause local diseases—*e.g.* meningitis, cholera-nostras, etc.—which



have no resemblance to typhoid fever. Staübli,<sup>3</sup> in discussing the question of paratyphoid, gives as causes of the typhoid symptom complex—Eberth's bacillus, *b. paratyphoid* A, *b. paratyphoid* B, and the *bacillus enteritidis* of Gärtner, which is closely allied to the paratyphoid B. Brion and Kayser<sup>4</sup> found the *b. flavosepticum* (an organism of the *pyocyaneous* group) in some cases. Thus some paratyphoid bacilli closely resemble those which give rise to certain forms of meat poisoning. There are three main forms of meat poisoning—(1) Botulism, in which nervous symptoms predominate, due to the toxins produced in preserved meat, sausages, etc., by a non-pathogenic anaerobe, *b. Botulinus*. (2) Acute diarrhoea due to putrid meat, from *b. proteus*. (3) Meat infection due to the presence of *b. enteritidis*. It may cause epidemics of acute gastric enteritis or "typhoid"; in some cases the symptoms of the latter succeed the former. In the one case the infection is mainly local; in the other, general. As a rule, epidemics of "typhoid" due to *b. paratyphosis*, are milder than those due to Eberth's bacillus.

It might seem as though this departure from an insistence on the specific nature of typhoid fever, and the return from the bacteriological to the clinical definition of the disease, is rather a retrograde step, but this is only apparent. The difficulty is that only by careful bacteriological examination is it possible to distinguish between the different infections causing clinical typhoid. Even the agglutination test is of little use on account of the occurrence of "group agglutination" (*vide* IMMUNITY DIAGNOSIS, p. 237). It is, therefore, impossible to establish a clearly defined group of "paratyphoid" infections by reference to the agglutinating power of the patient's serum, and it is equally impossible to do so from the post-mortem appearances. Courmont and Lesceur<sup>5</sup> urge that the words "paratyphoid," etc., should be allowed to drop. The Widal test being inapplicable to the differentiation of the various typho-colon infections, the diagnosis should be made from blood cultures, on which an etiological classification can be based.

#### *Transmission of the Infection of Typhoid.*

*Flies and Dust.*—There is no doubt that the infection of typhoid may be conveyed both by flies and by dust. In the South African War both these factors played an important part in the spread of the disease. The bacilli may simply adhere to the limbs of flies, or may be swallowed by them and subsequently deposited in the excreta. It is stated that the bacilli may live in the body of the fly for more than three weeks. Typhoid bacilli soon perish if they are dried, but where dust storms are frequent, as was the case in South Africa, some organisms may survive and be deposited on food in this way.

*Typhoid Carriers.*—As has been stated above, typhoid bacilli, after entering the blood stream, are excreted by the liver, and some penetrate to the gall bladder, where they flourish luxuriantly. Their growth is especially favoured by the catarrh of the gall bladder which their presence usually excites. The discovery that the gall bladder is a favourite nidus for the organism is of great importance in connection with the perpetuation of the disease, for it has now been abundantly proved, first by the researches of Kayser and Förster<sup>6</sup> and other hygienists in Strasburg, and later by observations made here and in America, that a certain number of typhoid patients, women more especially, continue to harbour in their biliary passages, and to excrete by the bowel, numbers of virulent bacilli for months and even years after recovery from the disease. A point of minor interest is the possibility of there being in some cases a relation



between typhoid cholecystitis and the subsequent occurrence of gall-stones. The proportion of female to male bacilli carriers is about 3 or 4 to 1, almost the same as that which exists between female and male sufferers from gall-stones. Moreover, Blumenthal and Kayser have discovered typhoid bacilli in the interior of gall-stones.

It is obvious that the existence of these healthy bacilli carriers explains the occurrence of outbreaks of typhoid in localities where infection from a typhoid patient can be excluded, and many instances of this have been discovered of late years. The now classical case of a Strasburg female baker was described by Kayser in 1906. Almost every new employee in her bakery contracted typhoid sooner or later, and two died. The fæces of the proprietor, who had had typhoid ten years before, swarmed with bacilli. In other cases reported by Friedal, a bacilli carrier (cook) served in eight houses during eight years, and during that time infected 24 persons. A. and J. C. G. Ledingham<sup>7</sup> describe the case of an asylum in which, since 1893, a series of small outbreaks of typhoid (31 cases in all) occurred. All external sources of infection having been excluded, the fæces of the females in the establishment were examined, and three bacilli carriers were found.

Bacilli carriers can be divided into two classes—those who get rid of the organism in the course of a few weeks, and those who harbour bacilli for months or years. The latter are known as “chronic bacilli carriers” or “continuously infective” (*dauerausscheider*) as opposed to simple “bacilli carriers” (*Bacillen träger*). According to Frosch<sup>8</sup> women form 60 per cent. of all bacilli carriers, and 82 per cent. of the continuously infective; children under 15 are seldom continuously infective (4 per cent.); more frequently bacilli carriers (35 per cent.). When it is remembered that women form a numerically small percentage of all cases of typhoid, and yet contribute a large quatum to carrier cases in general; further, that most of them engage in domestic work and cookery, we see that a woman who has had typhoid is not unlikely to be a source of danger. Bacilli carriers have only been recognised for about five years, so that it is impossible to obtain bacteriological evidence as to the extreme limit of time for which a person may remain infectious. In 310 cases observed 144 were infectious up to 3 months, 64 for 3 months to 1 year, 102 for 1 to 3½ years. In 25 cases in which the beginning of the infection was based on the history alone, it lasted from 4 to 9 years in 14, from 10 to 20 years in 6, and from 20 to 30 years in 5. A noteworthy point in connection with bacilli carriers is that they excrete enormous numbers of bacilli, and that the bacilli disappear from and reappear in the fæces in a highly irregular manner. A single negative examination, therefore, is inconclusive. The bacilli are as virulent as those in patients actually suffering from typhoid fever. Frosch gives the following statistics as to the frequency of bacilli carriers in S.-W. Prussia. Among a total of 6708 patients, 310 (4·6 per cent.) excreted bacilli for more than 10 weeks after convalescence. Of these 310, 144 ceased to be infectious within 3 months; 166 remained continuously infective. Out of a population of 2,300,000 souls 276 cases of typhoid were traced to the 310 carriers. In a series of 978 cases of typhoid the source of infection was ascertained as follows:—71·2, another patient; 23·7, food or milk; 5·1, a carrier case.

There is, unfortunately, no known method of dealing effectively with bacilli carriers. Cholecystectomy has been performed in cases with gall-stones; even this is not always successful in curing the infection.



Attempts at intestinal disinfection, and at active immunisation, have proved equally futile. The detection of bacilli carriers, and the instructions given to them as to the need for disinfection of the hands and stools, have, in S.-W. Prussia, greatly reduced the morbidity from typhoid from this particular source.

*Bacilluria.*—According to Easton<sup>9</sup> and Knox<sup>10</sup> typhoid bacilli are found in the urine of about 21 per cent. of patients. They are usually very abundant—many millions in each c.cm. The invasion of the urine takes place during the later stages of the disease, and the organisms may persist for months or years. In most cases the bacilluria is curable by urotropin, even if cystitis is present.

*Symptomatology.*—Little has been added to the clinical picture of typhoid during the past few years. We may refer, however, to the now numerous observations on local typhoid infections which do not give rise to the general symptoms of typhoid fever. Thus nephritis (Napier and Buchanan<sup>11</sup>), pyelitis (Brownlee and Chapman<sup>12</sup>), pleurisy, jaundice, and meningitis (Arzt<sup>13</sup>) due to Eberth's bacillus, or the bacillus of paratyphoid, may occur. The fact that typhoid fever predisposes to the development of arterio-sclerosis has been referred to elsewhere (see ARTERIO-SCLEROSIS).

*Typhoid Spine.*—This has attracted some attention. It is an acutely painful affection of the spine, which occasionally comes on during an attack of typhoid fever. Wilson<sup>14</sup> has collected records of 21 cases. It is almost limited to males, is predisposed to by hard manual work, and usually begins during the first fortnight of the disease. There is severe pain in the lumbar region accompanied by rigidity of the spine; the pain is paroxysmal and radiates in different directions. The duration of the symptoms varies, but there is a considerable tendency to chronicity, up to a year or more, with remissions and exacerbations. Pyrexia is common. There is sometimes tenderness over the spine, and in some cases scoliosis or kyphosis develops. Many of the patients are described as "hysterical"; the reflexes may be abolished; in a few cases patchy anæsthesia of the legs, or incontinence, have occurred. The best treatment is to immobilise the spine, and to give morphia for the relief of pain. Recovery seems always to take place. The nature of typhoid spine is not quite certain. It has been looked on as a neurosis similar to irritable spine (Osler), to a perispondylitis affecting the periosteal structures (Gibney), associated with inflammation of the nerve roots (Wilson). M'Crae<sup>15</sup> showed by radiograms that in his case new bone had been deposited in and round the vertebral column; he regards the condition as an infective spondylitis. Suppuration has never been observed.

*Abdominal Reflex in Typhoid.*—From an investigation of the abdominal reflex in 45 cases, Rolleston<sup>16</sup> found that it was affected in 93 per cent., and absent in 68 per cent. It reappears as convalescence begins, and again disappears if relapse occurs. For practical purposes he divides the reflex into supra- and infra-umbilical; the latter is the first to go and the last to return. Rolleston concludes that abolition of the abdominal reflex in a patient under 50 is confined to nervous diseases and certain acute abdominal affections, especially typhoid and appendicitis; it may therefore be of diagnostic importance in cases of chronic pyrexia.

*Diagnosis of Typhoid.*—The Widal reaction still holds the first place in everyday work. For the macroscopic agglutination test a dead



culture may be used. Ficker's "typhus diagnosticum" is a dead culture sold for this purpose; other similar preparations are in the market. Agglutination tests, however, cannot be relied upon to differentiate between the various typho-colon infections. Among other diagnostic methods are:—(1) *Blood cultures*.—These have been alluded to. Cultures made from the rose spots also yield a positive result in most cases, but as by the time the rose spots appear the diagnosis is usually established, the method is not of practical value. The isolation of the bacilli from the stools is difficult. The Drigalski-Conradi method (for details of which a special text-book must be referred to) is regarded as the most satisfactory. (2) The method of *complement deviation* has also been applied to the diagnosis of typhoid fever (see IMMUNITY DIAGNOSIS. (3) *Oculo-reaction*.—Chantemesse<sup>17</sup> introduced the method of instilling into the conjunctival sac an extract made from dead typhoid bacilli. Patients suffering from typhoid, and bacilli carriers, are said to react. Kraus, Lusenberger, and Russ<sup>18</sup> have confirmed his observations to this extent, that they get a reaction in typhoid fever, but they also found that a good many patients suffering other diseases (tuberculosis, etc.) reacted. Healthy persons did not react. The test has not been much employed; its value, if any, is negative—*i.e.* absence of a reaction probably excludes typhoid. A corresponding cutaneous test is even less trustworthy (Orszag<sup>19</sup>).

*Treatment—Prophylaxis*.—Apart from the steps which should be taken to combat such sources of infection as flies, dust, and bacilli carriers, a method of antityphoid inoculation has been elaborated by A. E. Wright, and was extensively employed during the South African War. A vaccine consisting of dead bacteria is used; two injections, with a fortnight's interval between them, are given. Inoculation is followed by some constitutional disturbance (fever, etc.) and enlargement of the adjacent glands. There is a temporary lowering of the resistance to infection, followed by a period of increased immunity lasting for about 2 years. Wright believes that the incidence of typhoid in the army was diminished by about half in the inoculated, and that the death-rate among them was about half what it was in uninoculated troops. "Among 19,069 inoculated soldiers there were only 226 cases of typhoid fever, a proportion of 1 to 84.4, and of these 39 died, which equals 17 per cent. Among 150,231 uninoculated soldiers there were 3739 cases of typhoid fever, that is 1 in every 40 took the disease, and the death-rate in this class was 25 per cent." (quoted by M'Crae<sup>20</sup>). Leishman<sup>21</sup> has more recently stated that the mortality among the uninoculated is 20 times as great as among the inoculated. Antityphoid serums have also been prepared, and used in prophylaxis, by Bassenger and Mayer,<sup>22</sup> Meyer and Bergell,<sup>23</sup> and others.

*Serum Treatment*.—This is as yet in the experimental stage. Antitoxic serums have been used by Chantemesse<sup>24</sup> and Jez; antibacterial serums by others. Chantemesse states that the mortality with his serum has been only 4.3 per cent., as opposed to a mortality in the other Paris hospitals of 17.7.

*Diuresis*.—Cushing and Clarke,<sup>25</sup> and other American physicians lay great stress on giving large quantities of water to typhoid-fever patients. They urge the patients to drink 4 ozs. of water every quarter of an hour, and try to give from 8 to 14 pints in the course of twenty-four hours. Marked polyuria is established as a result of this copious



drinking. Both the severity and the mortality of the disease are said to be diminished under this treatment.

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## Uterus, Malignant Tumours of.

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SINCE the *Encyclopædia Medica* was published two notable advances have been made in our knowledge of the malignant growths of the uterus, viz. a more correct estimate of the nature of the so-called DECIDUOMA MALIGNUM (see Vol. X. p. 178; XIII. p. 227), and the introduction of more thorough methods of dealing with MALIGNANT TUMOURS OF THE UTERUS (Vol. XIII. p. 227). To each of these advances some paragraphs must be set apart.

CHORIONEPITHELIOMA (*Deciduoma Malignum*). — *Pathology*. — The recognition of the true nature of this tumour was delayed for some years in Great Britain by the decision of the Committee of the Obstetrical Society of London in 1896, the decision being that the growth was only a sarcoma of the uterus. Yet S. Gottschalk (*Arch. f. Gynaek.*, xlv. pp. 1-100, 1894), in a paper entitled "Das Sarcom der Chorionzotten," published in 1894, had stated his belief that the tumour was not (as Sänger had said) developed from the decidua but took origin primarily in the foetal tissues and was indeed a sarcoma of the chorion arising from the cells of Langhans's layer and the stroma of the villi. Further, a year later, L. Fraenkel (*Arch. f. Gynaek.*, xlix. pp. 481-507, 1895) described a case, and expressed the opinion that the tumour arose from the syncytium of the chorionic villi and not from decidua ("syncytioma malignum" or "carcinoma syncytiale"). But by far the most important contribution to the subject (since Sänger's paper of 1889) was contained in Marchand's articles of 1895, 1898, and 1901 (*Monatssch. f. Geburtsh. u. Gynäk.*, i. p. 513, 1895; *Zeitsch. f. Geburtsh. u. Gynäk.*, xxxii. p. 405, 1895; *Berl. klin. Wochensch.*, xxxv. p. 249, 1898; *Zeitsch. f. Geburtsh. u. Gynäk.*, xxxix. p. 173, 1898; *Münch. med. Wochensch.*, xlvi. p. 1303, 1901; *Journ. Obstet. and Gynec. Brit. Emp.*, iv. p. 74, 1903). This writer maintained that the tumour was neither a carcinoma nor a sarcoma, but a special and peculiar growth resembling both; that it was composed of cells from both layers of the epithelium covering the chorionic villi; and that it was, therefore (according to the conception then formed of the origin of the chorionic epithelium), of both maternal and foetal origin. It had been noted that a hydatid mole often preceded the appearance of deciduoma malignum,



and Marchand applied himself to the histological consideration of the former and came to the conclusion that its essential character was not found in myxomatous degeneration of the stroma of the villi, but in excessive growth of the epithelium covering these chorionic projections. He noted next that the cells of the hydatidiform mole and those of the deciduoma malignum were strikingly alike, and that they infiltrated the maternal tissues and invaded the blood-vessels in the same way; and he found that in certain hydatidiform moles (termed *malignant*) the histological appearances were exactly the same as those in deciduoma malignum (the tumour which, from 1898 onwards, he named *Chorionepithelioma*). It was easy to trace the connection between the epithelium of the hydatid mole and that which covered the villi in the normal placenta; and by-and-by connecting links were found joining together the three formations (chorionepithelioma, hydatid moles, simple and malignant, and normal placenta); and the connecting links were chorionepitheliomata containing villi (Apfelstedt and Aschoff, *Arch. f. Gynäk.*, l. pp. 511-547, 1896; Neumann, *Monatssch. f. Geburtsh. u. Gynäk.*, iii. p. 387, 1896; *Wien. klin. Wochensch.*, ix. p. 604, 1896; *Monatssch. f. Geburtsh. u. Gynäk.*, vi. p. 17, 1897). These conclusions and identifications were materially aided by the researches of Peters and others on early human ova; and so it came to be established that both the layers of epithelium covering the villi were of foetal, or, better, ovular, origin, and that, therefore, the deciduoma malignum was not a maternal but a foetal tumour. This change of view is most clearly shown in the terminology of the subject, in the substitution of chorionepithelioma for deciduoma malignum. But some years elapsed before these new ideas could make their way in England against the opinion which the Obstetrical Society of London had formulated in 1896, although, in Scotland, Teacher and Kelly (*Journ. Path. Bacteriol.*, v. p. 358, 1898) and Haultain (*Journ. Brit. Gynæc. Soc.*, xv. p. 190, 1899) had described cases showing that the tissue of the tumour was the same as the epithelium of the chorionic villi and that the tumour actually had its origin in the villi. British opinion may be said to have been finally brought into line with the Continental and American view (as expressed by Marchand) only in 1903, when Teacher published his masterly monograph on the subject (*Journ. Obstet. and Gynæc. Brit. Emp.*, iv. pp. 1-64, 145-199, 1903). It is true that for a time Veit and his followers maintained that the tumour was a sarcoma of the uterus associated with a pregnancy and that the latter fact accounted for the presence of foetal elements, which were, therefore, not to be regarded as essential parts of the neoplasm; but Marchand's view has steadily gained ground whilst Veit's contention that disease of the mother cannot arise from the foetus has not been strengthened.

But it was not long till the occurrence of tumours closely resembling the chorionepithelioma outside the uterus, apart from pregnancy, and even in the male subject opened up a new field of inquiry. In the first place typical chorionepitheliomata have been found as primary growths of the vagina. Hicks (*Journ. Obstet. and Gynæc. Brit. Emp.*, xii. pp. 119-129, 1907) reported such a case in 1907, and was able to gather together fourteen certain instances from literature, the earliest of which (Pick's and Schmorl's) were published in 1897. To explain these extra-uterine tumours it has been supposed that emboli containing the tissue of the chorionic villi migrate from the uterus and settle in more or less distant organs and tissues, and develop there into chorion-



epitheliomata. In the reported cases there was generally the history of a vesicular, mole, or, less often, of a simple abortion or of a full-term pregnancy; the growth apparently spread by the peri-vaginal veins, and there was some evidence that the infecting cells might lie latent for months. Again, in 1897, Kanthack and Eden (*Trans. Obstet. Soc. Lond.*, xxxviii. pp. 149, 171, 1897) reported cases of tumours (in the liver) histologically indistinguishable from chorionepitheliomata found apart altogether from pregnancy, and Lubarsch's specimen (*Arb. a. d. Posenen Instit.*, p. 230) of a growth arising from the uterus came from a girl of 13 years who had never menstruated. But, further, tumours apparently identical with the chorionepithelioma began to be discovered in the male. Schlagenhauser (*Zentralb. f. Gynäk.*, xxvii. p. 82, 1903; *Wien. med. Wochensch.*, May 1902) recorded how a man, 43 years of age, suffered from a tumour of the left testicle of a friable nature; there was, also, a secondary growth in the lung; and the tumours from both organs showed, under the microscope, syncytium and the cells of Langhans's layer. Further, the testicular growth described by Breus in 1878 was re-examined by Schlagenhauser and was found to be associated with secondary growths in the veins of the spermatic cord, and these could be traced through the inferior vena cava with the right auricle of the heart; the tumour itself contained syncytial masses. Here, then, were cases of deciduoma malignum in the male, and of hydatidiform mole in a man's heart! These occurrences bridged across the gulf between malignant tumours of the uterus and teratomata of the testicle, and at once brought what had been a purely local manifestation of disease into touch with the whole problem of cancer and of its possible origin of malignant growths in embryonic structures or "relics." Ritchie's discovery of a mediastinal tumour with the characters of a chorionepithelioma in a young man tended to draw attention more directly in this country to the occurrence of "deciduoma malignum" in the male. Other cases were reported by Wlassow (*Virchow's Arch.*, Bd. clxix. p. 220), and more recently by Emanuel (*Zentralb. f. Gynäk.*, xxviii. p. 143, 1904), by Fisch (*Interstate Med. Journ.*, xiii. p. 441, 1906), by Bernstein (*W. London Med. Journ.*, xii. p. 128, 1907) and by Emrys-Roberts (*Journ. Path. Bacteriol.*, xiv. p. 135, 1909). It must now be regarded as certain that chorionepithelioma occurs in both sexes, and in both has malignant characters, although it is more frequent in women, probably because of its well-known connection with pregnancy and the hydatidiform mole. In the male sex it would seem to be generally connected with a teratoma in which, it must be conceded, that there were embryonic relics corresponding to the stage of development in which the chorion and its villi are present (Eden, *Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 433, 1907). This conclusion is supported by the fact that this malignant growth has been found to arise from ovarian teratomata in the female, when the presence of pregnancy could be excluded (*e.g.* in Pick's patient who was 8½ years old, *Berl. klin. Wochensch.*, xli. pp. 158, 195, 1904). We may summarise the progress of our knowledge of the pathology of the chorionepithelioma by saying that it is a malignant tumour consisting mainly of syncytium and of cells closely resembling those of Langhans's layer in the chorionic villi; that it most often occurs in the female and in the uterus, but may be met with in other organs (either secondarily or, very rarely, primarily), and even in the other sex (generally in association with teratomata of the testicle); and that it arises either



from cells of the chorionic villi (especially in connection with a hydatidiform or cystic mole) or from some structure which has "the morphological value of an included matured and fertilised ovum." Since it arises either from the chorionic epithelium or from its forerunner, the trophoblast, it might be termed a trophoblastoma, but the term chorion-epithelioma has been fairly well established in use and may be accepted as satisfactory. But it must be borne in mind that such a neoplasm is peculiar neither to the uterus nor to the female sex.

Little can be safely affirmed of the etiology of chorionepithelioma. When we know the cause of cancer, we may perhaps be within touch of that of the chorionepitheliomata; on the other hand, the investigation of the latter may throw a flood of light upon the former question and the wider one. The following facts have been established: Chorion-epithelioma occurs most often in individuals in adult life, and it is noteworthy that the age of predilection is actually thirty-three; its tendency to follow a molar pregnancy or an abortion is well known (but unfortunately the cause of the hydatidiform mole is itself a mystery, and it is not yet possible to say what form of mole is most likely to precede a chorionepithelioma); and it may be surmised that excessive trophoblastic activity has a causal influence, especially if combined with deficient resistance of the maternal tissues.

There is little to be added to the *clinical signs and symptomatology* of chorionepithelioma (vide *Encyclopædia Medica*, X. p. 179; XIII. p. 227). Its clinical connection with abortion has been fully borne out by reported cases, but it may follow on full time labour and even the birth of a living child (Hicks, *Journ. Obstet. and Gynæc. Brit. Emp.*, xvi. p. 179, 1909); it may also occur after the menopause, e.g. Krösing's patient was 52 years of age, and it was three years since her climacteric was reached (*Arch. f. Gynæk.*, lxxxviii. p. 469, 1909). In Fairbairn's case (*Journ. Obstet. and Gynæc. Brit. Emp.*, xvi. p. 1, 1909) there were almost no uterine symptoms, and operation revealed what was apparently a primary chorionepithelioma of the left ovary. *Diagnosis* founded upon curetting of the uterus is not always reliable, for the scrapings may not contain the distinctive cellular elements; the symptomatology, therefore, should not be lost sight of in coming to a conclusion. After removal the tumour can easily be recognised by its microscopical appearances. *Prognosis* is less grave than was at first thought; apparently the chances of recovery after operation are greater when the tumour has followed a hydatid mole than when it has developed after a full time pregnancy. Out of 99 cases submitted to *radical treatment* (vaginal hysterectomy), Teacher's collected statistics showed 63 recoveries, of which 24 remained well for more than a year. The occurrence of metastatic deposits while lessening the chances of recovery does not necessarily preclude operation.

**LITERATURE.**—In addition to the articles already referred to, those of RISEL (*Über das maligne Chorionepitheliom*, 1903; *Zeitsch. f. Geburtsh. u. Gynäk.*, lvi. p. 154, 1905), of GARKISCH (*ibid.*, lx. p. 115, 1907), of RUNGE (*Zwei Beiträge* (Greifswald), 1907), of GREEN and HUNTER (*Internat. Clinics*, 17 S. iv. p. 188, 1907), of W. RISEL (*Ergeb. d. allg. Path. Anat.*, xi. p. 928, 1907), of BRENNER (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. pp. 574, 713, 1908), of PAZZI (*Ginecologia*, v. p. 504, 1908; *Clin. ostet.*, x. p. 314, 1908), of LOCKHART (*Montreal Med. Journ.*, xxxvii. p. 784, 1908), of HORMANN (*Monatssch. f. Geburtsh. u. Gynäk.*, xxix. p. 198, 1909), and of LABHARDT (*Zentralb. f. Gynäk.*, xxxiii. p. 805, 1909) may all be consulted with profit. NAPIER BURNETT's monograph, which appeared in the *Northumberland and Durham Medical Journal* for September 1908, is an admirable summary of the chorionepithelioma problem.



CANCER OF THE CERVIX.—Two matters of considerable importance fall to be chronicled under progress in the subject of uterine cancer; one has to do with the earlier recognition of the disease, and the other relates to the choice of the plan of surgical procedure to be adopted.

What has been called the "crusade against cancer of the uterus" may be said to have commenced in 1890 when Clement Godson wrote a paper on the importance of the earlier recognition of the disease by paying attention to the symptom of bleeding occurring at, after, or near to the menopause. He showed that in 600 cases of cancer of the cervix bleeding had been the first symptom in 461 (76·6 per cent.), and the only symptom in 225 (37·5 per cent.); pain and discharge usually came on later (*vide* Godson's letter in the *Brit. Med. Journ.*, ii. for 1907, p. 854). Winter approached the subject in 1891 (*Berl. klin. Wochens.*, xxviii. p. 809, 1891), and returned to it again in 1904 (*Die Bekämpfung des Uterus Krebses* (Stuttgart), 1904; *Zentralb. f. Gynäk.*, xxviii. p. 441, 1904), when he was able to report that wonderful progress had been made in securing earlier recognition of the disease in East Prussia. It is interesting to note what Winter found to be the causes which prevented patients consulting their doctors early: in 30 out of 69 patients the delay was due to ignorance of the symptoms of uterine cancer, in 19 it was ascribed to laziness, in 4 to modesty, in 14 to fear of doctors, and in 2 to lack of money. W. Anstruther Milligan summarises in a useful fashion the progress of the movement in the various countries of Europe up to the end of 1906 (*Journ. Obstet. and Gynec. Brit. Emp.*, xi. pp. 45-63, 1907). The literature of the subject is already considerable (*vide* Milligan's article, p. 57); but little had been done of a practical nature in this country till the late Dr. Cullingworth wrote to the *British Medical Journal* (14th Sept. 1907), and the Council of the British Medical Association appointed a Committee to consider the best means of promoting the early recognition of uterine cancer. H. R. Spencer's paper and the discussion which followed the reading of it (*Brit. Med. Journ.*, ii. for 1907, p. 431 ff.) were instrumental in arousing the attention of the medical profession. Since then more systematic efforts have been made to disseminate a knowledge of the first symptoms of cancer of the womb: an appeal has been made to medical men to investigate at once (by a physical examination) all cases showing these symptoms; the significance of bleeding at the menopause is being insisted on in the lectures and text-books given to and prepared for nurse pupils in hospitals; and pamphlets setting forth the advantages and means of early recognition of the disease are being circulated among midwives, nurses, and health visitors. The British Medical Association, for instance, in its circular appeal to midwives and nurses, points out that "cancer of the womb is a very common and fatal disease in women, but it can be cured by operation when it is recognised early. A woman sometimes tells a nurse or midwife her ailments before she speaks to a doctor, and the nurse or midwife has then an opportunity of aiding our crusade against this terrible disease. Cancer may occur at any age, and in a woman who looks quite well, and who may have no pain, no wasting, no foul discharge, and no profuse bleeding. To wait for pain, foul discharge, or profuse bleeding, is to throw away the chance of successful treatment. The early signs of cancer of the womb are—

1. *Bleeding*, which occurs after the change of life.
2. *Bleeding* after sexual intercourse, or after a vaginal douche.
3. *Bleeding*, slight or abundant, even in young women, if occurring between the usual monthly



periods, and especially when accompanied by a bad-smelling or watery blood-tinged discharge. 4. *Thin watery discharge* occurring at any age. The nurse or midwife who is told by a patient that she has any of these symptoms should insist upon her seeing a medical practitioner in order that an examination may be made without delay. By doing so she will often help to save a valuable life, and will bring credit to herself and to her calling." Information such as is contained in the above circular will doubtless lead to the earlier recognition of cancer and therefore to operation at a time when there is some reasonable hope of cure. Already there are signs that women are beginning to understand the possible significance of metrorrhagia and even of menorrhagia at, after, or near the menopause (Meyer-Ruegg, *Zentralb. f. Gynäk.*, xxxi. p. 629, 1907). Even extreme old age does not seem to interfere with the rule that a red vaginal discharge after the menopause is suspicious, for Findley (*Amer. Journ. Obstet.*, Oct. 1902) has reported a case of cancer of the cervix in a woman aged 93, whose daughter had died of the same disease at the age of 48; the old lady thought it was a "return of the period." Further, medical men are recognising more clearly the variability of the early signs of cancer, and are resorting more to microscopic examination of scrapings from curettings, or of pieces of tissue removed by excision.

While this "crusade" has been starting, gynecologists have been endeavouring to decide what form of *operative interference* promises the best results in uterine cancer. At first, the introduction of vaginal hysterectomy marked a distinct advance: there was a great reduction of the operative mortality, and the operation itself was shorter and less difficult of performance. Yet it was not long before it began to be found that the after-results were not so satisfactory. Halliday Croom (*Trans. Edin. Obstet. Soc.*, xxiv. p. 6, 1898) picked 14 out of 260 cases of cancer of the cervix as suitable for the operation of vaginal hysterectomy; in all of them the operation was quickly recovered from, but all of them were dead within a year from the recurrence of the disease. Six years later Duret and Besson (*Rev. de gynéc. et de chir. abd.*, viii. p. 395, 1904) reported 40 cases in which the vaginal operation was performed, and 23 in which the abdominal route was followed; among the former cases there were 6 deaths (15 per cent.), and among the latter 10 (43·4 per cent.); further, of the 9 cases of the latter group which recovered from the operation, all died within one year, while of the vaginal cases 13 were free from a return of the disease at the end of two years. Still there was a strong tendency among operators, notwithstanding these unfortunate statistics, to develop the abdominal operation, and to seek for a means of dissecting out affected glands in a systematic and complete fashion (Ries, *Surg., Gynec., and Obstet.*, Sept. 1905). When, therefore, Wertheim (*Brit. Med. Journ.*, ii. for 1905, p. 689) in 1905 announced that "since the autumn of 1895, he had, with a few exceptions, operated on all cases of carcinoma affecting the cervix and portio vaginalis by the abdominal route," he found the profession ready to give him a sympathetic hearing. He further stated that he was able, by freeing the ureters and separating the bladder and rectum, to remove the cancerous uterus with a great deal of the surrounding cellular tissue and lymphatic glands. The Wertheim operation, thus introduced, gave 60 to 70 per cent. of patients free from recurrence of the disease after four or five years' observation, a result which no other method had yielded. It was recognised at



once that its performance vastly increased the number of cases of cancer of the cervix and vaginal vault that should be considered as operable; but it was also evident that it was a long and somewhat difficult operation to perform, and entailed great anatomical knowledge and operative skill, dexterity, and care. Berkeley and Bonney (*Brit. Med. Journ.*, ii. for 1908, p. 961), however, were able to report 18 cases of carcinoma of the cervix operated on by the Wertheim method; 3 of these died from the operation, and of the 15 who survived, 14 were alive at the time of writing and showed no signs of recurrence, but, as the authors pointed out, the time had been too short to afford any certainty of permanent cure. Berkeley and Bonney thought that the operation, notwithstanding its technical difficulties (which were much greater in advanced cases than in early ones), would be in a few years the only one carried out for the cure of carcinoma of the cervix. They have modified certain steps in the procedure, such as the separation of the bladder, the clamping of the vagina to prevent infection of the operation area, and the stitching of sterile linen to the edges of the incision. Cuthbert Lockyer (*Brit. Med. Journ.*, ii. for 1907, p. 443) regarded Wertheim's method as "*the operation of the future, and the only scientific operation for carcinoma cervicis at the present time.*" The stages of the operation may be enumerated. First, the cancer is disinfected as far as possible by the vagina (scraping, cauterising, etc.). Then, with the patient in the Trendelenburg position, the abdomen is opened. The posterior layer of the broad ligament is divided and the ureters exposed; the bladder is separated from the supravaginal cervix of the uterus and rolled back by digital pressure effected through a swab; the infundibulo-pelvic, round, and broad ligaments are ligatured and divided; the uterine vessels, with the surrounding cellular tissue, are next ligatured and divided, and then the vesical portions of the ureters can be completely separated; next, the posterior layer of the peritoneum is divided and the rectum separated from the vagina; the vagina is again cleansed at this stage, clamped in its upper part, and then cut across; the cancerous organ is now removed, and the dissection of the lymphatic glands proceeded with, every one that is at all enlarged being extirpated. The cavity of the wound is then lightly packed with gauze which extends to the vulva, and the peritoneum is closed by sewing together the anterior and posterior flaps above the operation area which is being drained by the gauze. Finally, the abdominal wound is closed. Berkeley (*Journ. Obstet. and Gynec. Brit. Emp.*, xv. p. 145, 1909) has published, during the present year, an able summary of results and a fair estimate of the advantages possessed by the Wertheim operation over simple vaginal hysterectomy and paravaginal section. Over the former operation (vaginal hysterectomy) Wertheim's panhysterectomy has the advantage of a far greater range of operability, and much larger number of permanent cures; but the primary mortality is higher. In other words, the patient runs a greater risk but has a better chance of permanent cure. The advantage would seem to be largely due to the removal of the parametrium in the Wertheim procedure, and to the thorough way in which the vagina is dealt with. Schauta's paravaginal section (*Monatssch. f. Geburtsh. u. Gynäk.*, xix. p. 475, 1904), the operation devised in 1893 by Schuchardt, enables hysterectomy to be performed by the vaginal route, and at the same time secures free access to the parametrium which is to be removed. The paravaginal incision is



“begun in the left vaginal vault, at about the level of the cervix, and is carried forward through the left paravaginal and pararectal tissues, the left labium, the left levator ani and coccygeus muscles, the cellular tissue of the left ischio-rectal fossa, and the skin of the perineum and of the lateral anal region back to the sacrum.” Bleeding from the incision is dealt with by fine catgut ligatures. “The next step in the operation is to circumcise the vaginal wall at the junction of the upper with the middle third of the vagina, and dissect it off from the rectum and bladder. This cuff of vagina is then sewed over the cervix so as to shut off the cancerous area from the operative field. The ends of the ligatures employed for this purpose are left long and are used as tractors to control the position of the cervix. The cervix is now separated entirely from the bladder and ureters, and the vesico-uterine pouch is entered. Douglas’s pouch is opened, and the dissection of the parametrium from the ureter and pelvic wall, the isolation and ligature of the uterine artery, etc., is begun. After the uterus and parametrium have been removed, the anterior and posterior leaflets of the peritoneum are united by suture, and the paravaginal incision is closed. Vaginal drainage is used” (Henrotin in Kelly and Noble’s *Gynecology and Abdominal Surgery*, i. p. 789, 1907). There would seem to be, according to Berkeley (*loc. cit.*, p. 156), a general opinion that Schauta’s paravaginal section is more difficult than Wertheim’s operation, that its primary mortality is as great, that the percentage of operability is less, and that the percentage of cures is also less; at the same time Sir W. J. Sinclair (*Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 241, 1906) is strongly in favour of it. Both Wertheim’s panhysterectomy and the Schuchardt-Schauta paravaginal section are long and complicated operative procedures, but they are directed towards the complete removal of cancer of the uterus, and as the end is a great one, so the means by which it is to be reached may be expected to be arduous. The fact that Polosson had 36 consecutive cases of Wertheim’s operation without a death does much to remove the dread of a high operative mortality (Berkeley, *loc. cit.*, p. 168). Until some way of preventing cancer or of dealing with it by non-surgical means be found, the gynecologist must be prepared to use the methods which surgery provides.

Uterus, Non-Malignant Tumours of.

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DURING the past few years the chief advances that have been made in connection with fibroid tumours or fibro-myomata of the uterus have been an extension of their operative treatment by abdominal sub-total hysterectomy and a clearer realisation of the dangers which may arise if they are left alone (as used to be done) until the menopause.

*Etiology.*—Whilst it cannot be said that the causation of fibroids of the uterus is yet discovered, there is a general tendency to regard them as associated in some way or other with irregularities in the performance of the reproductive functions. Pinard (*Ann. de gynéc. et d’obstét.*, 2 S. ii. p. 1, 1905) believes they are connected with disuse rather than with use or abuse of the genital organs, and he thinks that the



most evident predisposing cause is failure to permit the process of reproduction to pass through its usual stages on to its legitimate and proper conclusion. In other words, impregnation should be followed by pregnancy and a full-time labour, and labour should be succeeded by lactation. Further, late marriage (opsigamy) and secondary sterility have something to do with the development of uterine fibroids, as is shown by the fact that out of 171 cases in which these growths complicated labour, no less than 94 were primiparæ, and of them 80 were thirty years old or more; of the total number 85 per cent. had married late in life. Pinard puts his conclusion into an easily remembered phrase when he says, when you have to do with a primipara of thirty years or more in the labour room, "cherchez le fibrome," and he adds that it is sterility that causes fibroids rather than fibroids that cause sterility. Alongside these facts one must put the records of uterine fibroids in two or more of the same family, suggesting family prevalence, if not heredity. Doran, for instance, operated by hysterectomy upon three sisters for fibroids of the uterus (*Brit. Med. Journ.*, ii. for 1905, p. 924), and Macpherson Lawrie (*ibid.*, i. for 1904, p. 357; ii. for 1907, p. 1342) operated upon four sisters, while a fifth was similarly treated in a hospital. But when we come to consider the question of heredity we must take into account the frequency of this neoplasm, for it is so common that the fact of its occurring in two or more of a family is by no means inexplicable, quite apart from family predisposition. Further, Doran's three patients were all above thirty years of age and were all unmarried, so that even in this case Pinard's generalisation is of value.

The *prognosis* of uterine fibroids is now held to be graver than it was thought to be some five or ten years ago. This is the result of the greater knowledge which has been obtained of the life-history of these tumours, made possible through more frequent operations. Doubtless in the past death was often ascribed to complications (pulmonary, renal, and cardiac) when it was really due to the uterine myoma. As far back as 1902 the late Dr. Cullingworth (*Journ. Obstet. and Gynec. Brit. Emp.*, i. pp. 3-28, 1902) published an analysis of 100 cases of uterine fibromyomata in which the condition of the tumours and the complications to which they had given rise were verified by operation. Of the 100 cases 89 had been operated on by abdominal hysterectomy and 9 by myomectomy. Forty-six of the tumours were, so to say, healthy and typical, 2 were unusually vascular and had no capsule, and *fifty-two* had some form of secondary degenerative change. Among the last-named were 27 which showed œdematous and myxomatous change, 18 showing necrotic changes (either necrobiotic or infected), and 5 showing cystic and fibro-cystic degeneration; 1 was myxo-sarcomatous, and 1 was calcareous. Twenty-two cases had complications due directly to the tumour; there were serious peritonitic adhesions in 12, hydrosalpinx in 5, a twisted pedicle in 2, dilated ureters and hydro-nephrosis in 1, etc. The tendency to take a graver view of fibroids of the uterus was much strengthened by these statistics, and more recent articles further bear this out. Piquand (*Ann. de gynec. et d'obstét.*, 2 S. ii. p. 335, 1905) has investigated 175 cases of calcified fibroids; in a considerable number of these cases (111) no surgical interference took place, and many of the patients died from the fibroid; 64 patients were operated upon and 12 died (18 per cent. mortality). Obviously, calcification of the fibroid, which was at one time the result hoped for, by no means



saves the patient's life; indeed, the operation for its removal would seem to be a specially dangerous one. The "red degeneration" of fibroids has been shown to be due to thrombosis of the blood-vessels, and its occurrence predisposes to infection with septic organisms (Lorrain Smith and Shaw, *Journ. Obstet. and Gynec. Brit. Emp.*, xv. p. 225, 1909). C. P. Noble (*Journ. Obstet. and Gynec. Brit. Emp.*, x. p. 436, 1906) pleads for earlier operation, and bases his plea on the fact that degenerations or complications existed in 1550 out of the 2274 cases (68 per cent.), and that cancer and sarcoma of the uterus occur more frequently than is supposed as complications of fibroids. Piquand (*Ann. de gynéc. et d'obstét.*, 2 S. ii. pp. 393, 485, 565, 1905; *Rev. de gynéc. et de chir. abd.*, ix. p. 579, 1905) had also noted this association of malignant growths with fibroids, and had drawn the same conclusion from it; and Winter (*Monatssch. f. Geburtsh. u. Gynäk.*, lvii. pp. 8-66, 1906) thought that there was a direct relation between cancer and uterine myomata. All gynecologists, however, are by no means at one on this subject, and Haultain (*Trans. Edin. Obstet. Soc.*, xxix. p. 173, 1904), for instance, was of opinion that malignant disease was but slightly predisposed to by fibro-myomata, and might be looked upon merely as a coincidence; at the same time, the volume of evidence in favour of the frequency of the association of the two morbid states is considerable. Another risk run by the woman who has a fibroid growth of the uterus is *axial rotation* of the tumour or (what is still more dangerous) of the whole uterus. Haultain (*Trans. Edin. Obstet. Soc.*, xxx. p. 197, 1905) has recorded two such cases, and others have been reported by Boursier (*Sem. gynéc.*, x. p. 329, 1905), Bland-Sutton (*Trans. Obstet. Soc. Lond.*, xli. p. 149, 1905), Lacouture (*Journ. de méd. de Bordeaux*, xxxvi. p. 364, 1906), Cameron (*Brit. Med. Journ.*, ii. for 1905, p. 714), Pichevin (*Sem. gynéc.*, xi. p. 209, 1906), Schultze (*Samml. klin. Vortr.*, N. F., No. 410, 505, 1906), Gayet (*Lyon méd.*, cix. p. 272, 1907), Bérard (*ibid.*, cx. p. 374, 1908), Grosse (*Gaz. méd. de Nantes*, 2 S. xxvi. pp. 241, 261, 1908), Pellet (*Normandie méd.*, xxiv. p. 255, 1908), Schulte (*Gynaek. Rundschau*, ii. p. 729, 1908) and Connell (*Journ. Obstet. and Gynec. Brit. Emp.*, xvi. p. 184, 1909). When all these risks are borne in mind, it is not wonderful that gynecologists, instead of being afraid to remove the myomatous uterus (as they were some fifteen years ago), are now afraid to leave it unoperated upon.

The *treatment* has varied little during the past few years. The sub-total or supravaginal form of hysterectomy is still the operation of choice, although conservative gynecology demands the performance of simple myomectomy (hystero-myomectomy) as often as it is possible to get the neoplasm away without too great a risk. It is becoming customary, also, to try to save one or both ovaries unless these are markedly pathological. It is true that ovarian cysts have sometimes developed after the removal of the fibroid uterus, and Broun (*Amer. Journ. Obstet.*, lix. p. 307, 1909) has ascribed these tumours to the disturbance of the circulation following hysterectomy; but it is not generally felt that the danger is a great one. Frequent performance of the sub-total hysterectomy has led to a simplification of the procedure, and a lessening of the mortality directly due to the operation. In 1903 Haultain (*Trans. Edin. Obstet. Soc.*, xxviii. p. 128, 1903) reported 42 cases of uterine myoma treated by myomectomy or by hysterectomy (panhysterectomy in 3 cases, supravaginal in 28) with 1 death (in one of the panhysterectomies); in 1905 his list contained 120 hysterectomies



with 3 deaths (*ibid.*, xxx. p. 105, 1905), and in 1906, 203 supravaginal operations with 2 deaths (*Brit. Med. Journ.*, i. for 1906, p. 233); and he has recently (*Trans. Edin. Obstet. Soc.*, xxxii. p. 121, 1907) put on record 30 cases of cervical fibroids removed by abdominal hysterectomy with 3 deaths. Other operators have been able to report similarly good results, and Noble (Kelly and Noble's *Gynecology and Abdominal Surgery*, i. p. 711, 1907) has gathered together statistics which show that supravaginal hysteromyomectomy has a mortality, in uncomplicated cases, of 1 per cent., in average cases of from 2 to 4 per cent., and in seriously complicated cases of 10, 20, or 30 per cent.; that myomectomy in strictly selected cases has a mortality of about 3 per cent., and of about 5 per cent. when the selection is not so strict; and that total hysterectomy may be said roughly to be nearly twice as dangerous as the supravaginal operation. Thus, in Kelly's clinic there were 306 myomectomies with 14 deaths (4·5 per cent.), and 691 hysteromyomectomies with 22 deaths (3·1 per cent.). Werder (*Amer. Journ. Obstet.*, liv. p. 736, 1906) had 118 operations with 1 death, Webster 100 with 3 deaths, Bland-Sutton 100 consecutive hysterectomies for fibroids with no death (*Journ. Obstet. and Gynæc. Brit. Emp.*, xiii. p. 328, 1908), and Noble 115 with no death at all (the 115 operations consisting of 104 abdominal sections and 11 vaginal myomectomies). This is a marvellous achievement of gynecology: it is not much more than twenty years ago since Keith abandoned hysterectomy for Apostoli's electrical method of treatment on account of the mortality of the former procedure, and now hysteromyomectomy has a mortality as small or smaller than Keith himself obtained in his wonderful ovariectomy lists. In this relation Vanderveer's article on evolution in the history and treatment of uterine fibroids (*Amer. Journ. Obstet.*, lix. p. 169, 1909) may be studied with interest. So much has the attitude of the profession altered in respect to uterine fibroids that C. H. L. Reed (*Brit. Med. Journ.*, ii. for 1906, p. 1197) has made the general statement that the menopause is a poor surgeon, and that the only safe place for a fibroid of the uterus, however small or large, however soft or hard, however recent or old, is outside the patient's body. The only cases in which operation may be postponed or omitted are those in which the tumour does not cause bleeding, or exert pressure, or exhibit signs of infection or malignancy, or which has ceased to grow. Of course, the presence of a complication which would make operation as dangerous as the tumour would also be a cause for consideration, delay, or abandonment of operative interference. There are still unsettled questions, *e.g.* the advisability of early rising after operation for fibroid tumours (see Brothers's article in the *Medical Record* of New York, lxxi. p. 476, 1907; and C. Hartog's in the *Zentralb.f. Gynäk.*, xxxi. p. 1610, 1907), the method of closing the abdominal incision (through and through sutures, or by layers), the direction (vertical, transverse, curvilinear) of the abdominal incision (see Maylard, *Brit. Med. Journ.*, ii. for 1907, p. 895), and the fate and value of belated ovaries (Bland-Sutton, *ibid.*, ii. for 1908, p. 10; Doléris, *Ann. de gynéc. et d'obstét.*, 2 S. iv. p. 641, 1907); but the broad principles of the operation are all well established, with the result that what was a dangerous procedure in 1896 has now a mortality (in the hands of practised gynecologists) of less than 2 per cent.

### **Uterus, Prolapsus and Retro-deviations of.**

—No very marked advances in the treatment of uterine displacements fall to be recorded as having been made during the past five or six years



since the articles in the *Encyclopædia Medica* (IX. p. 257; XIII. pp. 171, 179, 1903) appeared.

In 1904 Bantock (*Trans. Edin. Obstet. Soc.*, xxx. p. 34, 1904-5) wrote in defence of the pessary as a means of treating uterine displacements; and challenged the statements made by Macnaughton Jones and Giles (*Med. Press and Circ.*, N. S. lxxvii. p. 439; lxxviii. p. 1, 1904) as to the dangers of such supports, and the allegation that they were necessary evils. He spoke in strong terms of the "mania for surgical interference which characterises the present-day gynecology," and was of opinion that "for a case of uncomplicated retroversion in which the uterus is perfectly mobile and capable of being raised into its normal position, either bimanually or by means of the sound . . . the only legitimate treatment is that by a properly adapted pessary." He thought, also, there was a prospect of *cure* in a large majority of the cases; and he preferred Britannia or white metal as the material out of which the pessary should be made, for the shape could be easily altered and retained, the presence of an irritating muco-purulent discharge was indicated by blackening of the metal, and it was easily cleaned. Several of those who took part in the discussion which followed the reading of Dr. Bantock's paper held views resembling those laid down therein; and there can be no doubt that in the profession generally a great many practitioners make use of temporary measures (pessaries and supports) for the treatment of uterine displacements in patients who are averse to operation, or who cannot, for various reasons, undergo such interference. It is to be hoped that these practitioners are as careful as Dr. Bantock in the choice of the supports employed, and in the way in which the treatment is carried through. B. C. Hirst also (*Therap. Gaz.*, 3 S. xxi. p. 289, 1905), and Hofmeier (*Münch. med. Wochensch.*, liii. p. 1649, 1906), have written in a somewhat similar way about the pessary treatment of displacements. At the same time, there can be no doubt that the trend of theory and practice in gynecology is still strongly in the direction of operative interference, and that the abdomen is being frequently opened in order to carry out this interference.

*Alexander's operation* of shortening the round ligaments of the uterus is extensively practised, but there is still considerable difference of opinion as to the best method of performing it. It may be done, as Alexander proposed, by the extraperitoneal operation; this method has practically no mortality, and, in the case of women who may reasonably expect to bear children, it is to be preferred, for it does not interfere with the changes incident to pregnancy and labour; but difficulty is occasionally experienced in finding the ligaments externally, and the results of the shortening are not so certain or so permanent as when the procedure adopted is the intraperitoneal one. In 1903 Baldy (*New York Med. Journ.*, lxxviii. p. 167) proposed, as had been done previously by Webster, to shorten the round ligament by passing it through an opening in the broad ligament (under the Fallopian tube) and suturing it to the posterior surface of the uterus; but Noble (Kelly and Noble's *Gynecology*, i. p. 539, 1907) condemned this method on theoretical grounds, and advocated *Gilliam's operation* in which the proximal end of the round ligament is sutured to the anterior abdominal wall, the aponeurotic sheath, rectus muscle, and peritoneum being perforated, and the ligament fixed to the aponeurosis of the external oblique. Gilliam's operation is really a round-ligament ventro-suspension of the uterus, and, as modified in F. Simpson's retroperitoneal shortening (*Trans. South.*



*Surg. and Gynec. Assoc.*, xv. p. 223, 1903), would seem to possess obvious advantages. J. W. Taylor (*Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 415, 1907), however, is impressed with the safety and value of the extraperitoneal operation, and uses it save in cases where adhesions exist; in 170 operations there was no mortality, and the results as to the position of the uterus were very satisfactory, for in three only of the number was there a relapse. Before shortening the ligaments Taylor dilated and curetted the uterus, and put it in a position of complete anteversion, with a pessary to retain it.

It is difficult to speak decisively regarding the value of shortening of the *utero-sacral* ligaments in prolapsus and retro-displacements. It may be done either by vaginal section (the posterior vaginal fornix being incised without opening into the peritoneum, and the two ends of each ligament being sewed together) or by opening the abdomen and suturing together the two ends of each ligament on their peritoneal aspect.

The operation of *ventral suspension*, known also as hysterorrhaphy, ventrofixation, and hysteropexy, was introduced more than twenty years ago by Kelly and Olshausen; but there is still a lack of uniformity regarding its advantages, its dangers and inconveniences (immediate and remote), and the best method of performing it (see Giles, *Brit. Med. Journ.*, ii. for 1906, p. 1188, and Herman, *ibid.*, ii. for 1908, p. 790). It would seem that, if the abdomen is to be opened, some combination of plication of the broad and round ligaments with attachment of the uterus to the anterior abdominal wall will best achieve the end in view, viz., retention of the uterus in an anteverted position at its normal level *quâ* the pelvis with sufficient mobility not to interfere with the normal progress of a future pregnancy and with the safe accomplishment of a future labour.

**Word Blindness, Congenital.**—The first case of congenital word blindness was reported by Morgan in 1896; Hinschelwood has lately recorded twelve instances of the condition. It is sometimes a hereditary, or at least a family, disease, for four of Hinschelwood's patients were children in one family of eleven. In congenital word blindness the incapacity may extend only to letters; figures are sometimes recognised without difficulty. In the diagnosis of the condition refractive and other ocular defects and mental deficiency must be excluded. Hinschelwood states that children afflicted with word blindness may nevertheless ultimately learn to read. They ought, however, to be withdrawn from an ordinary school, and specially taught.

REFERENCES.—HINSCHELWOOD. *Brit. Med. Journ.*, 2nd Nov. 1907.—JACKSON. *Amer. Journ. Med. Sci.*, May 1906.

**X-Rays in Skin Diseases.**—The X-ray treatment of tinea capitis, favus, tuberculosis, carcinoma, and lupus erythematosus is discussed under the various diseases.

**SYCOSIS.**—The epilating power of the rays has been made use of in the treatment of sycosis, but to get permanent results from this method doses sufficient to destroy the hairs and leave a permanent scar are necessary. Unless this is done, when the hairs regrow a recurrence is to be expected.

**ACNE.**—In acne small doses of X-rays are very beneficial in addition to ordinary local treatment. In this disease the production of a reaction with its subsequent atrophy of the skin is to be avoided.



**ACNE KELOID.**—In the condition on the back of the neck known as acne keloid, X-ray treatment gives very good results, causing a rapid disappearance of the keloid-like growths and a check to the spread of the disease.

**KELOID AND HYPERTROPHIC SCARS.**—Ordinary keloids also sometimes yield to X-rays, and the rays can be relied on to cause an improvement in the hypertrophic scars which are so often associated with scrofuloderma.

**LICHEN PLANUS.**—Many itchy eruptions are also benefited by X-rays, both as regards the eruption and the itching. This is especially the case in lichen planus. In the more chronic forms a few exposures to the rays often give wonderful relief from the itching which is so troublesome in such cases; but it requires repeated exposures to cause a disappearance of the eruption.

**ECZEMA.**—The only form of eczema in which X-rays are to be recommended is in the chronic patchy form where isolated spots resist all other forms of treatment. Here, too, in addition to having a good effect on the eruption it gives great relief from the itching. For such cases only small doses should be given.

**PRURITUS ANI.**—In pruritus ani X-rays also often give great relief, but care must be taken not to expose the genital organs.

**WARTS, MOLLUSCUM CONTAGIOSUM.**—Multiple warts and molluscum contagiosum, especially the latter, yield rapidly to a few applications of X-rays and disappear in a surprisingly short time.

**NÆVI.**—In nævi varying results have been obtained. Some pigmented nævi yield to X-rays, but Finsen light or a combination of X-rays and Finsen light give better results. The angiomatous nævi are also susceptible to X-ray treatment. The superficial ones do better than the deeper ones. These nævi, of course, cannot be destroyed without giving sufficient doses to cause some atrophy of the overlying skin.

**MYCOSIS FUNGOIDES.**—Of the rarer skin diseases the one in which X-rays can be depended on to give valuable assistance is mycosis fungoides. The rapidity with which large tumour masses in this condition disappear after exposure to X-rays is very astonishing. Small doses should be given, as a too rapid breaking down of the tumours with a rapid absorption into the system of the broken-down products is apt to cause a sudden toxæmia with a fatal result.

**REFERENCES.**—MORRIS and DORE. *Light and X-ray Treatment of Skin Diseases*, 1907.—WETTERA. *Handbuch der Röntgen Therapie*, 1908.—JAMIESON. *Brit. Journ. Derm.*, Jan. 1903.



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